

Aviation Week & *Space Technology*

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May 14, 1962

Titov Reports
On His Orbital
Vostok 2 Flight

F-105 Rocket Firing





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Nuclear Engine for Nuclear Vehicle Application—the key to future exploration of outer space, at ranges far beyond the reach of even the most sophisticated conventional propulsion system. NERVA is part of the ROVER program, which calls for deep space probes powered by a nuclear upper stage, using the liquid metal powered Saturn as booster. Aerojet is responsible for overall NERVA design and research and development of components, and the Atomic Energy Division of Westinghouse Electric for the nuclear reactor, which is based upon the Kivi-B reactor work conducted at the Atomic Energy Commission's Los Alamos Scientific Laboratory. The Space Nuclear Propulsion Office, jointly operated by AECOMASA, has overall responsibility for the NERVA program.



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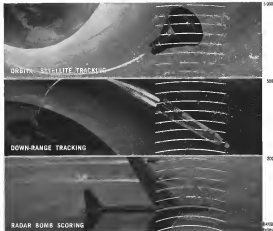


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Qualify equipment, meeting accuracy requirements, in other laboratories before use in the field.

AEROSPACE CALENDAR

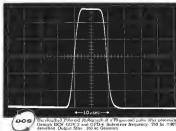
- May 11-22—Annual Meeting and Aviation For Safety Summit, National For Protection, Ann. Sheraton Hotel, Philadelphia, Pa.
- May 19-25—Second Annual Air Transportation Conference, New York University, Washington Square Center, New York, N.Y. Co-sponsors: International Transport Institute.
- May 11-25—Eighty Aerospace Instrumentation Symposium and National Teleconferencing Conference, Sheraton Park Hotel, Washington, D.C.
- May 12-24—Conference on Self-Organizing Systems, Museum of Science and Industry, Chicago, Ill. Sponsors: Office of Naval Research, Amstar Research Foundation.
- May 21-26—National Microwave Theory & Techniques Symposium, Institute of Radio Engineers, Boulder, Colo.
- May 12-25—Annual Convention and Exhibition, American Society for Quality Control, Sheraton Hilton Hotel, Cincinnati.
- May 24-26—Seventh Region Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.
- May 24-27—International Space Aeronomics, Opa Loria Airport, Miami, Fla.
- May 25—Symposium on Recent Developments in Aerospace Sciences, Institute of the Aerospace Sciences, Los Angeles.
- May 26-June 2—44th Annual Wright Visiting Elder Meet. For information: Steering Society of Drilling, Inc. For info: Ranch, P.O. Box 151, Dayton 19, Ohio.
- (Continued on page 7)

AVIATION WEEK and Space Technology

May 14, 1982
Vol. 24, No. 22

Aviation Week and Space Technology is the premier publication in the aerospace industry. It is the only publication that provides a comprehensive overview of the entire aerospace industry, from the latest developments in space technology to the most advanced aircraft designs. The magazine is published weekly and is available to subscribers for a nominal fee. It is a must-read for anyone involved in the aerospace industry, whether as a professional or as a hobbyist. The magazine covers a wide range of topics, including space exploration, aircraft design, and the latest in aerospace technology. It is a valuable resource for anyone interested in the aerospace industry.

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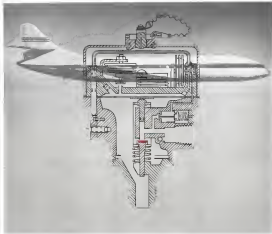
For more information, complete specifications, etc., write to Dept. AW-2-3.

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At Canada, Du Pont of Canada Limited, P. O. Box 668, Montreal, Quebec.

TEFLON is the first registered trademark for its family of fluorocarbon resins, films and filaments, including TFE (tetrafluoroethylene) resins and FEP (perfluoropolyethylene) resins.

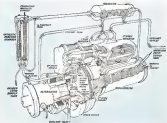
DUPONT **TEFLON®**
FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING... THROUGH CHEMISTRY

AEROSPACE CALENDAR

(Continued from page 1)

- June 4-11/62 North Congress, Stelio Hilton Hotel, New York 26, N. Y.
- June 5-7-Symposium on Standards for Fabrication: Woodcock Plastics, North Olathe Laboratory, Wichita 65, Mo.
- June 5-6-English Annual Radar Symposium (classified secret), Institute of Science and Technology's Radio Laboratory, University of Michigan, Ann Arbor.
- June 7-14/62 North American Mach. Conference: Regency-Fairfield Hotel, Seattle Wash.
- June 8-9/62 National Maintenance and Operations Meeting, Training Activities Service, Inc., Bethesda 14, Pa.
- June 11-13-62 National Conference, National Aviation Electronics Council, Seattle, Wash.
- June 13-14-Annual Meeting, Steel Transfer and Fluid Mechanics Institute, University of Washington, Seattle 5, Wash.
- June 17-22-Symposium General Meeting: American Institute of Electrical Engineers, Denver 14/62 Hotel, Denver 14, Colo.
- June 18-19-Vacuum Metallurgy Conference, American Vacuum Society, New York University, New York 17, N. Y.
- June 18-19-10-Materials Subject Matter Institute on Nuclear Reactor Fuel Elements, University of Florida, Gainesville, Fla.
- June 18-19-Symposium: American Institute of Aeronautics and Astronautics, Los Angeles 14, Calif.
- June 19-20-Symposium: American Institute of Aeronautics and Astronautics, Los Angeles 14, Calif.
- June 20-21-Annual Convention, Aeronautics and Astronautics, Los Angeles 14, Calif.
- June 21-22-Annual Meeting, American Society for Testing and Materials, Steel Institute Hotel, New York 17, N. Y.
- June 22-23-62 North American Symposium on Military Electronics Institute of Radio Engineers, Mountain Hotel, Washington 25, D. C.
- June 23-24-Symposium on Electromagnetic Theory & Antennas, College Park, Md.
- June 24-25-Symposium: University of Kansas International Scientific Radar Union.
- June 25-26-Annual Conference, American Society of Mechanical Engineers, University of Maryland, College Park, Md.
- June 26-28-1962 North American Symposium: Meteorological Society, University of Alaska, Fairbanks, Alaska.
- June 28-29-Third International Symposium on Kinetic Gas Dynamics, University of Fair Play, Fair Play, Minnesota (AFOSR ONR, NASA, JSCS meeting).
- June 29-30-North American Symposium on Computers and Data Processing, by the University of Denver's Denver Research Institute, Eldorado Lodge, Estes Park.
- June 29-30-Annual Conference, Control Systems Institute of Radio Engineers, New York University, New York 17, N. Y.
- June 29-30-40th North American Symposium on Radar, Emergency Telecommunications Institute of Radio Engineers, Torrey Pines, San Francisco 16, Calif.
- July 7-11-1962 Annual All Women Technicians (Continued on page 9)



A SENSIBLE WAY TO PROVIDE ACCESSORY POWER IN SPACE VEHICLES

This is the Sundstrand **CRITHCYCLE**... a cryogenically fueled, fully integrated power generation and distribution control system. Sundstrand developed the turbine-driven **CRITHCYCLE** under a U.S. Air Force Systems Command contract. Powered by hydrogen and oxygen, the **CRITHCYCLE** is unique in that normally wasted heat from energy conversion (exhaust gases) and even metabolic heat from the crew is recovered by the exhaust loop and returned to the power cycle by latent-heat exchangers between each of the four stages of a single-flow turbine. Sundstrand has also developed a multi-stage recuperating version of the **CRITHCYCLE** for low power levels. This concept results in significant fuel consumption economy which has not been achieved by any other dynamic space power system. As a result fuel weight and volume are reduced. In addition, the **CRITHCYCLE** operates at room temperature eliminating need for high temperature materials, solving wheel containment problems, and greatly improving inherent reliability and safety. Since the **CRITHCYCLE** is independent of the environment, it is ideal for lunar missions.

■ The **CRITHCYCLE** is a versatile size, too. About the size of a gasoline lawn mower motor, it can be used in pairs for increased reliability. ■ Several versions of this space power system are being developed which will be suitable for missions of several weeks' duration... at power levels from one kilowatt to 50 kilowatts. Both the turbine prime mover (shown) and the recuperating machine have been publicly demonstrated to representatives of the aerospace industry and government services. ■ (A single request on your business stationery and we will send you details concerning this and the other accessory space power systems which Sundstrand has under development.) ■ If you would like to work on the Sundstrand Engineering team in the development of practical solutions to challenging space power problems, write to: Personnel Director.



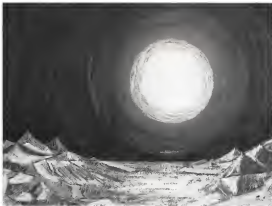
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SUNDSTRAND IS AN EQUAL OPPORTUNITY EMPLOYER

Scientific predictions indicate that solar activity will be at a minimum between July, 1964 and July, 1965. This has been designated as the International Year of the Quiet Sun, and during it a world-wide magnetic survey will take place.

□ The Douglas Space Physics and Planetary Sciences Group is studying scientific experiments to be performed on satellite and space probe missions during this period. Instruments to be used will be among the following: magnetometers; ionization chambers; G-M detectors; ionization; solid state detectors; and spectroscopeters. □ The present Douglas Aerospace Research Station program for the study of cosmic rays will continue through this "Quiet Sun" period and will provide important data relative to solar cosmic ray and auroral events and the geomagnetic K index. Douglas was invited to participate with the National Science Foundation in this program.

THE YEAR OF THE QUIET SUN ...AND WHAT DOUGLAS IS DOING ABOUT IT

will provide important data relative to solar cosmic ray and auroral events and the geomagnetic K index. Douglas was invited to participate with the National Science Foundation in this program.



Preparation for the Year of the Quiet Sun world scientific survey is one of more than 500 research projects that are under way at Douglas. Some of these relate to the solution of problems on programs of today and tomorrow. Others range through development and research programs whose effects may not be evident until ten or twenty years in the future.

DOUGLAS

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From Fortness, a Collins scanner system beams 12 voice channels 409 miles to a similar installation on Okla. And the reliability causes telephone toll quality. This over-water link required Collins complete service: site survey, systems engineering, equipment, construction, installation, test, maintenance and instructions. □ Reasons for picking and atmospheric distortion, Collins scanner systems are ideal for long-haul voice and data communications, telemetry and remote control, and radio and video relay. Up to 131 channels can be transmitted on a single RF carrier, using frequency division multiplexing. □ A pioneer in secret propagation, Collins started a continuing research program in 1945 and ever has been a leading supplier of systems for industry and government. Users include telephone, petroleum and mining companies, military applications include early warning, command control, logistics and transportable mobile missile weapon communication systems. □ Collins scanner communication systems employ a basic modular concept providing complete "building blocks" in the 1, 2, and 4 line bands with output power to 70 kw. for fixed station and transportable applications. □ If distance, over water paths, rugged terrain, and communication reliability are your problems, call Collins Radio Company, AD505-2331, Dallas, Texas.

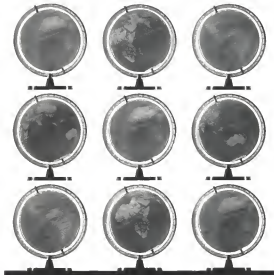


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This test-stand for large solid motors is one of the many giant-size facilities we're now building to help make our organization a second-to-none solid rocket center. The test bay is nestled into one of the rugged canyons in our new 6,000-acre production and testing facility. It can handle solid rockets up to 2,000,000-lb. thrust in either horizontal or vertical position. It will be used first to test the 120-inch solid motor we are developing under research contract to the Air Force. ■ In another recent contract, Lockheed Propulsion Company was selected by North American Aviation and NASA to design and build the solid escape motor for the Apollo spacecraft.

LOCKHEED PROPULSION COMPANY
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NEW TEST BAY FOR 2-MILLION-POUND SOLID MOTORS

Changing Climate for Management

(Background for the current stress on systems stress management, which was the subject of a top-level industry and Air Force Systems Command meeting at Monterey, Calif., two days ago, was summarized there by Lt. Gen. Harold W. Ellis, Jr., deputy AFSC commander for aerospace systems. Significant excerpts from his summary follow.)

Because of this continuing and explosive growth in our scientific and technical knowledge, the alternatives open to us in system design and configuration are staggering in number. The same applies to the solution of technical problems within a specific system program. The choices here are such that there is seldom a single answer or, from the technical standpoint alone, even a single best answer. The process of final selection from among this myriad of possible alternatives has therefore become exceedingly difficult while the necessity to serve at the instant most appropriate to existing and forecast circumstances has become ever more urgent. These conditions have demanded:

- First—that a capability be developed within the management structure to assess continuously the growing state-of-the-art across many fields of technical interest in order that all available alternatives to technical problem solution may be taken into consideration.
- Second—that the decision-making process be so arranged as to assure the most complete examination and study feasible of all possible alternatives, and that sound, mature and enlightened judgment be applied in the selection from among them of the course of action.
- Third—that management at all levels, to a far greater extent than ever before, be informed in depth and breadth so as to be instantly and effectively responsive to decision-making needs.

In former days, we organized success levels of management to establish a veritable span of control for each echelon and also to permit decisions to be made where the facts were available. Relatively speaking, the information passed to top management consisted of an integration of the many considerations involved at each level as a recommendation moved upward. In the military, this was known as "completed staff work."

In today's complex programs, all of the facts which must be taken into account are certainly not at the lowest levels. Rapid food decision-making has become essential. The new techniques can make the same information available to top and bottom management at the same instant. In effect, then, a wider span of control can be effectively handled by top managers, and top management can participate more directly in the several levels of the decision-making process.

This means that modernization of older and more conventional management structures can and should be effected so as to straighten and make more direct our decision-making channels.

Whatever may be the organizational structure adopted, maximum efficiency cannot be achieved unless today's data handling capabilities are properly used by management. Too much information at the top can be as self-defeating as too little. We run the risk that top management will be provided with a flood of data instead of a flow of analysis. It is also possible that an over-

contribution of control and direction might result, in which lower level analysis is neither completed nor requested. From my own operational experience, I can recall poor higher level decisions which would instead have been practical had the opinions of any crew chief been sought beforehand.

Information processing capabilities of today have thus generated a need for a new and critical look at management techniques, procedures and structures in order to reduce unwanted overhead and to realize the maximum potential increases in efficiency which are offered.

There are no easy or unprovoked answers to the hypercomplex and hyper-destructive thermodynamic/bellows/space age. Several examples are available of systems whose total cost from concept through final operational deployment is more than the total military budget of not many years ago. As compared with the hundreds of thousands of dollars which might have been accepted by a 1955 using in the field cost of the systems of several years ago, a similar saving today could amount to hundreds of millions. Costs are of such proportions today that the consequence of a single error in decision or in the selection of choice among the several alternatives could be an enormous variation in dollar resources required.

The same is true at rugged system complexity. In many of the systems of today and of the future, there is an extremely thin line between efficient performance and dismal failure.

As Gen. (Bernard A.) Schriever (AFSC Commander) stated so emphatically in his opening remarks, this places a premium today on thorough cost analysis, sound cost estimation and firm cost control. Financial systems must provide the ready accessibility which will permit cost integration between projects and major elements of projects and which will foster cost accountability throughout at frequent intervals. I do not know of any management techniques which need more attention in the future than this one.

The advances of science and technology now permit us to accomplish many of our military objectives by what might be called technical finesse rather than by weight of numbers. Management structures which were configured to high volume production of systems developed from a relatively well understood technical art and influenced by long practiced techniques will not meet the demands of the future. We must structure ourselves for longer development periods based on newly emerging technologies. As Dr. (John S.) Foster (director of Lawrence Radiation Laboratory) said yesterday, we must reach out into the slightly radical, yet have within our management capabilities the checks and balances to prevent us from reaching too far. Production management must institute methods and controls which are guided by new and increasingly demanding standards in the areas of close tolerances and super high reliability. Since the change in the nature of our future systems is one of the most obvious reasons for management change, I will not dwell on it. Let us emphasize, however, that its significance will be ever more apparent as we progress further into our space programs. ■

In the Front Office

William B. Ertle, executive vice president, Lockheed Aircraft International, Los Angeles, Calif.

Robert J. Manna, assistant vice president defense marketing, General Precision Inc., Tarrytown, N.Y.

Lloyd W. Harrison, president, Lyle Control Systems, according to Gail Hicks, new vice chairman of the board.

W. B. Kessler, vice president engineering, United Air Lines, and **R. L. Mansfield**, vice president cargo sales.

Ernest H. Feltus, vice president engineering, Clancy Aerial Industries, Inc., Farmington, Ill., according to **Wayne B. Johnson**, retired.

Reginald L. McGowan, vice president and treasurer, Armet Control Corp., Santa, Calif.

Joan G. Callahan is vice president, Perkin Elmer Products, Los Angeles, Calif. Mr. Callahan continues as general manager of the Technical Products Division.

E. Douglas Graham, vice president operations, The Radio Corporation of America, Department of Electronics, Los Angeles, Calif.

Edward M. Owen, Wilmington, D.C., representative for Lockheed-Singer Corp. replacing **F. E. Newbold, Jr.**, now a vice president of Itek Corp. Mr. Newbold continues as a director of Fairchild Industries.

Honors and Elections

The following awards for 1967 have been announced by the American Helicopter Society, the 1st Asia-Europe International Trophy, presented by General Aircraft Corp. for outstanding achievement in the advancement of the helicopter art, to **Michael L. MA**, Swiss helicopter designer, the **Dr. Alexander Koenig** award, for notable achievement in the advancement of rotary wing aircraft, to **Eng. G. Robert R. Williams**, commander of U.S. Army Aviation Center, Fort Rucker, Ala. for Capt. **William J. Rucker Award**, for greatest achievement in practical application or operation of rotary wing aircraft, to the Air Rescue Service at the Military Air Transport Service, the **Frederick L. Flushing Award** for general high level of performance, as recognized by the Lt. Col. Francis M. Owens, commander, 503rd Flying Training Squadron (Helicopter), Royal Air Force, the **Charles E. Bell Award**, for outstanding work in the development of rotary wing aircraft, to the engineering organization of Sikorski Aircraft. Also, **AHS** Distinguished Fellowship, for merit shown in work in the advancement of rotary wing aircraft, were presented to **Ed. Gene Hamilton II**, Houston, USA, and **Don Ross McClellan**, director of the Vertical Lift Aircraft Center of the Army Research Laboratories. The following awarded *Professional Achievement International* recognition of highly progressing work awards, **Col. Capt. USARP**, for altitude and tactical skills, **Capt. Bruce E. Usher, USN**, for tactical, **Cdr. Patrick Sullivan, USN** for a new three-blade rotor, **Lt. Robert Graham, USN**, for a new 11/21-in. rotor.

(Continued on page 37)

TOUCHDOWN ON THE FIRST PASS

A new air traffic surveillance system, Texas Instruments ASR-4, provides accurate position information on this jetliner and other traffic within 60 miles. Result: touchdown on the first pass.



Look to TI for answers to your radar problems in—

- air surveillance
- ground surveillance
- submarine detection
- missile guidance
- fire control

■ The ASR-4 is industry's answer to a Federal Aviation Agency request: "Develop a surveillance radar system to reduce field-approach congestion and minimize stack-up time at U.S. airports—make it operate reliably in all weather—continuously for 20 years." ■ Many air terminals already have the TI ASR-4. Custom modifications to this versatile radar system can be made to meet your organization's requirements.

APPROPRIATE DIVISION
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AND SEVEN IN TEXAS



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INDUSTRY OBSERVER

■ Proposals for Air Force Systems Command's Space Systems Division competition for additional transfer stage to be used above Titan 2 core of Titan 3 configuration were submitted last week by Aerojet-General, Bell Aerospace, North American Aviation's Rocketline, Thiokol's Rocket Motor Division and United Technology. Also intended to be used with Titan 2 alone, in some space missions under the Titan 3 program, this stage is still one of the more proposals in Titan 3. Stage will have two guidance systems with pass-out-of-projection, have a capability of multiple starts, and develop about 16,000 lb thrust total. Martin's Denver division will serve as vehicle integrator to combine the government-formulated transfer stage with Titan 2 core.

■ Revised schedule for Bell System Teletype active-commissioning satellite sale for launch scheduled in 1968 is due to define in complete form of the satellite. If launch is not successful, a backup satellite is expected to be scheduled for launch two months later.

■ First major subassembly of the Lockheed C-141 cargo transport—the fuselage of the first airplane—is scheduled to be completed by July. The C-141 program, which now calls for more than 300 airplanes instead of the 132 first proposed, will have 40% of the dollar going to subcontractors and another 25% to suppliers of government-financed equipment. Fiscal 1968 budget request is still \$214 million for the program.

■ USAF is in early stages of formulating a master plan for command and control, informally called ACE (Automatic Control Environment). Department of Defense has not yet approved development of the system.

■ Navy evaluation committee to select contractors to develop on-board needs for its version of the TFX fighter apparently has narrowed the field of four bidders to two: Hughes Aircraft and Republic (AW Aug. 3, p. 11).

■ Lockheed Martin and Sperry Co. and Ford's Aeromarine Division have been selected from a group of eight competitors by NASA's Marshall Space Flight Center to perform on-orbit studies of earth-Mars-Venus mission studies possible in the next few years. The studies will be performed by the Mars-Venus Mission Study (MVS) (AW Aug. 3, p. 30).

■ West German government reportedly is interested in strong the British Siddeley BS301 turboprop-driven turboprop turbofan engine in Germany. Engine has potential thrust of 10,000 lb (AW Aug. 23, p. 39) and will be principal component for the West German 1550 lightweight close-support fighter.

■ USAF's Electronic Systems Division is introducing a new standard cost format for use by companies making proposals, as part of a USAF effort to improve cost estimating. Format breaks the program into development, plant and production, and test and evaluation of each category. Now being applied to six new ESD contract out of a total of 14, the format was begun last program funded in the Fiscal 1967 budget.

■ USAF's proposed light test program for Titan 3 was designated as 62AA and standardized system-level system, calls for 17 vehicles, five of them Titan 2 vehicles and the rest complete, reusable boosters comprising a Titan 3 core with two 17-in. solid propellant motors strapped to its sides. Total program costs are estimated at \$1 billion.

■ RFI (Rocket-to-Flight Test) stage development contract award by NASA is expected this week. Final bidders are General Dynamics/Aeromarine, Lockheed Martin and Sperry Co., and Martin. Aerojet-General will develop the propulsion, Westinghouse will develop the motor.

■ Decision is imminent at AFSC's Ballistic Systems Division competition for boost vehicle to be used in conjunction with guidance and program Section of the vehicle will be conducted by the Air Force Research Center, Aerojet-General, Aerobics Development Co., Los Angeles Wright, Martin, Ford's Aeromarine Division and Hughes.

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Washington Roundup

New Patent Interest

Kenneth Adelman's firm is showing increased interest in developing a uniform patent policy for inventions made under government contracts. Dennis Winter, press director of the administration, is heading the latest White House effort to find a common ground between the patent policies of the Defense Department and the National Aeronautics and Space Administration.

Defense officials let the contractor take title to inventions while NASA stipulates title only after an invention is patented. Congress is split on the issue and probably will not resolve the issue until White House leadership. One group certainly believes should be considered part of the purchase when the government signs research contracts, while another faction argues such a policy discourages contractors from disclosing inventions or even accepting the work in the first place. A House space subcommittee recently recommended giving the NASA administrator more flexibility to decide whether the government or the contractor should take title to an invention (AVI Apr. 25 p. 30).

President Kennedy last week said he will recommend patent legislation to Congress if current agency studies show the need for changes. He said working out a uniform patent policy "is a difficult problem because you have to balance off the pros on the one hand and, at the same time, the incentives to companies to spend their own funds in order to develop patents which would give them a return on their costs."

House Centaur Probe

House Space Sciences Subcommittee is in investigation of the Centaur program thanks to call by William Van Allen, Marshall Space Flight Center director, and Dr. Homer Newell, NASA Office of Space Science director, as well as informal statements representing General Dynamics, Astronautics and Pratt & Whitney.

Chairman Joseph Keith told Aviation Week that after the inquiry, tentatively slated to start May 15, his subcommittee will issue an evaluation of the management of the Centaur program. He lacks his subcommittee did not get a full explanation for Centaur delays during exploratory hearings. Chairman George Miller of the joint House-Senate committee is somewhat cool toward the Centaur probe, feels it should have been held off until more reports about Centaur's failure (see p. 30) were submitted.

Senate Personnel Investigating Subcommittee remains in promoting profits hearings May 15 with offices of General Dynamics/Astronautics in witnesses. Boeing Co. and Boeing subcontractors will follow. Meanwhile, the Budget Bureau is studying subcontract cost allowances in Atomic Energy Commission, Defense and NASA contracts. Project is under William Armstrong, Budget Bureau's financial management chief.

Communication satellite legislation is expected to be approved by the Senate commerce committee May 15 substantially in the form it passed the House (AVI Apr. 7 p. 20).

Live Weekend Launch

Nuclear testing plans include the firing of an Atlas subcontinental ballistic missile next week with a nuclear warhead from Vandenberg AFB, Calif., in the Pacific region area. Administration and Defense officials feel the need to practice the warhead, although the risk of the Atlas exploding during launch is so slight and damaging to surrounding communities. The nuclear warhead itself is arranged so it would not explode in such a case. Although Vandenberg is on the coast and 100 mi. northwest of Los Angeles, the launch trajectory will take the Atlas away from populated areas.

Sequester legislation Ann is looking for a president to replace August C. Emerson, chief of the Strategic Defense Agency, May 15 because of upcoming defense budgetary problems. Lt. Gen. William "Spic" Ebert (ret.) is former USMC deputy chief of staff for procurement, has joined AIAA staff. He will survey the AIAA West Coast activities at first but eventually use direct ones.

Van Allen Belt Study

President Kennedy has ordered a study to determine whether the \$10 to \$15 million high nuclear explosion planned during the current U.S. test series "could cause some difficulty to the Van Allen belt in a way which would adversely affect satellite operation." Dr. James Van Allen, who discovered the belt, has called the proposed high-altitude test a "magical experiment" but other scientists have expressed fears the belt might be damaged by the blast.

Committee on Space Research (Cospar), on the closing day of its conference last week, decided to form a committee to investigate such controversial experiments. The committee is called Cospar's Group on Planetary Hazard Effects of Space Experiments but its members have not been named. —Washington Staff

NATO Fighter Decision Is Due in June

By Cecil Brownlow

Blanes—Secretary of the North Atlantic Treaty Organization is expected to meet its member states in June to decide on the final decision among four or five NATO aircraft designs to be selected to replace the aging F-4 Phantom II.

Most member states attending the annual Harrier Air Show (see p. 56) 127) will also directly concerned with the problem now to be solved. It is not clear if there is a new, or a possible, but the decision will be made by the end of the year.

Primary issue

Beyond the technical and cost issues, the question is to support the new life program for combat aircraft has emerged as a primary issue in the debate as a whole. An obvious, perhaps partial, comparison would be between the two types under consideration: the F-4 Phantom II and the F-16 Fighting Falcon. The F-4 Phantom II is a two-seater, multi-mission fighter, while the F-16 is a single-seater, multi-mission fighter.

Of the four aircraft available to the member states (see p. 56), two depend upon the same basic principle:



GENERAL CONFIGURATION of the advanced French Sidéer F-16 fighter. The F-16 is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter. The F-16 is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

—France's Dassault-Breguet M-16 and British Aircraft Corp's advanced variable-sweep design—two types available to NATO member states. The F-16 is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

Any decision, however, could be considered unless funding was cut. The F-16 is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

With various plans for France and West Germany to develop their own F-16, the decision is to develop their own F-16, the decision is to develop their own F-16, the decision is to develop their own F-16.

SEI, another partner, largely based upon the French and West German designs to develop their own F-16, the decision is to develop their own F-16, the decision is to develop their own F-16.

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level close-support aircraft. The M-16 is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

The BAC variant, the D-16, and the F-16 are a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

The D-16, also a variable-sweep aircraft, based largely upon the work of North American and West German designers, is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

With an external auxiliary fuel tank, mounted on top of the fuselage behind the cockpit, the D-16 reportedly could be the VAX equivalent, but its on-board fuel capacity is less than that of the F-16.

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ANNA Launch Fails

Cape Canaveral—Attempt to launch the ANNA probe satellite into orbit last May 10 failed when the Altair second stage failed to ignite. The cost was not immediately known.

It was planned to put the 100-lb satellite into a 500-mile orbit high 90 degrees of inclination at about 1000 miles. The probe, which was the first of a series of three, was launched from the Cape Canaveral Launch Complex on May 10. The launch was the first of a series of three, was launched from the Cape Canaveral Launch Complex on May 10.

10,000 lb. gross weight, the probe being developed under government contract to replace the first GHI in the late 1960s.

Speculation here is that a decision may be made within NATO on the type of satellite to order in the future, and the probe will be replaced by a new one.

Although the probe is not official data has been forthcoming on the BAC report, the probe is believed to depend upon the probe's design, which is a variable-sweep aircraft, based largely upon the work of North American and West German designers, is a single-seater, multi-mission fighter, while the F-4 Phantom II is a two-seater, multi-mission fighter.

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Polaris Shift Part of U.S. Move To Pressure Other NATO Nations

By George C. Wilson

Washington—U.S. commitment of five Polaris submarines to the North Atlantic Treaty Organization represents just one approach the Kennedy Administration is taking in its campaign to persuade West Europe to assist more heavily in the military effort.

The Polaris submarine commitment—announced in a speech during the NATO Council of Ministers meeting in Athens—last week, is a move to persuade the U.S. to assist more heavily in the military effort.

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effort to the French closer to NATO. The French government announced last week that it had expanded a nuclear force underground May 1 at its Sahel testing ground. This was the first nuclear test conducted by France since the country exploded on its own nuclear development program, rather than rely on NATO.

Nuclear agreements at the NATO meeting were limited to getting the countries in the alliance to agree on developing procedures for the use of tactical nuclear weapons and informing the governments of the size and location of nuclear stockpiles within their boundaries.

The type of psychological pressure the U.S. exerted on Athens in its effort to assist more of the NATO burden will be combined over the next several months with economic reforms intended to achieve the same objective. The U.S. is also looking for trade and West European property are opening the door.

Additional Funds

For Fiscal 1965, President Kennedy requested \$1.5 billion for the entire military assistance program, with \$500 million of it slated for NATO countries. The Kennedy Administration is working on adding \$200 million in requested or left over military assistance funds to boost the Fiscal 1965 total to \$1.7 billion. The \$1.7 billion for Fiscal 1965 comprises what President Eisenhower requested of \$1.4 billion for Fiscal 1962 and \$3 billion for Fiscal 1961. Congress met the Fiscal 1962 request to \$1.6 billion and the Fiscal 1961 request to \$1.3 billion.

The \$1.7 billion Fiscal 1965 request will be distributed four ways: Europe, \$514 million; Africa, \$333 million; Near East and South Asia, \$427 million; Far

Military Assistance to NATO Declining

North Atlantic Treaty Organization share of U.S. Military Assistance Program funds has declined from 41% to 31% over the last four years. The chart compares the percentage of MAP funds committed to NATO for each year, as well as NATO's Fiscal 1964 share of total MAP funds.

Region	FY1961	FY1962	FY1963	FY1964
Europe	10%	23%	20%	30%
Africa	2%	2%	2%	1%
Near East & South Asia	24%	22%	21%	16%
Far East	4%	4%	4%	3%
Latin America	5%	5%	5%	4%
Subtotal	3%	5%	4%	4%
Total	100%	100%	100%	100%
NATO	41%	36%	31%	31%

* Assistance that benefits several areas, such as communications equipment.

£142, 5333 million, Latin America, 557 million, general and covering more than one region, 547 million. Of the total, £296 million is slated to go for research and development and £151 million for acquisition and 572 million for electronic and communication improvements.

The \$314 million slated to go to Europe in fiscal 1985 is about \$180 million less than the total expected to be spent there this fiscal year. This reduction in U.S. grants also is reflected in the declining percentage of MAP funds going to Europe. Between fiscal 1982 and fiscal 1983, Europe's share is expected to drop from 21% to 15% (see accompanying chart).

McNassau justified the reduction this way before the Senate Foreign Relations Committee. "Most of the nations of continental Europe have developed economically to the point where they can careen their own defense budgets. By reducing its qualified aid to these nations, the U.S. programs in Western Europe are no longer an aid but an investment in the continued freedom of the Continent. The recent strengthening of U.S. forces in Europe indicates our determination that continental Europe should not be the theater of European developments."

Armament Sales

In addition to specific reductions the Kennedy Administration intends all armaments directly to NATO and other foreign countries whenever possible, rather than give them away. McNassau prohibited these direct sales which would save \$440 million in fiscal 1984, \$400 million in fiscal 1985 and \$300 million in fiscal 1986. The total cost-saving arrangements with MAP countries would bring U.S. arms market \$418 million in fiscal 1985.

Another indication of the administration's economic approach is to encourage NATO countries to pool their resources and manufacture their own weapons. William P. Bundy, deputy assistant secretary of defense for NATO security affairs, told the Senate Foreign Relations Committee such pooling

would "in essence, the political and economic posture of the alliance." He said the F-16s, all weather fighters which Belgium, Germany, Italy, and the Netherlands are producing in a cooperative effort. "This cooperative" Bundy said, "will provide these four nations with a common ability to support a common, guided aircraft for a common purpose."

The Administration's economic campaign also includes the endorsement of all agreements with Europe's NATO countries. No new grants of aid will be made in fiscal 1983 to Belgium, France, Germany, Italy, Luxembourg, The Netherlands or the United Kingdom. Assistance will be limited to fulfilling existing commitments and to training. The only new military aid program approved to spend the NATO budget was to be welcomed by Congress.

Radial Probes of Venus Indicate Its Surface Is Similar to Earth

Washington-Radar signals bounced off Venus suggest that its surface material and roughness are comparable to that of the earth, according to reports by scientists from Jet Propulsion Laboratory and Lincoln Laboratory radio have last week to the Third International Space Science Symposium, sponsored by the Committee on Space Research (COSPAR).

Radar probes of miles of the earth's distant planets can be accomplished when improvements, well within the cutting edge of the art are made in the National Aeronautics and Space Administration's JPL, California radar. JPL's W. R. Victor and Robertina Stevens told the meeting.

By increasing the power of the Goldstone transmitter from 11 kw to 100 kw, and cutting receiver noise in half, the scientists can detect the return of the radar. This would enable the radar to track Venus throughout its orbit around the sun which it passes within 25 million miles of the earth at 134-day intervals at its present time approach.

A modified Goldstone radar should be able to track Mars throughout its orbit, which enables about the terrestrial planet which approaches earth within 400 million miles of the earth once every 17 months. Also should be visible to the modified radar whenever it is above the horizon because of the "echo" from the earth's atmosphere. Mars, which approaches within 60 million miles at 26-month intervals would be detectable only during a portion of its orbit because of its small size. About half the diameter of the earth.

Two grants in fiscal 1983 will improve the U.S. radar system. The first will be for a new radar system for the U.S. Navy to be placed on the USS Enterprise (SSN-594) and the USS Thresher (SSN-595). The second will be for a new radar system for the U.S. Navy to be placed on the USS Thresher (SSN-595).

The time period of current research programs regarding the radar system program will not extend until late in the century when the latest is tested. But the launch of a new radar system is necessary to meet the needs of the U.S. Navy. The program is necessary to meet the needs of the U.S. Navy. The program is necessary to meet the needs of the U.S. Navy.

The radar probes of Venus have demonstrated that an ultrahigh-frequency (UHF) signal can be used for space communication over distances of 100 million miles with negligible errors. Victor and Stevens reported.

The present Goldstone facility is capable of detecting a 10 milliwatt transmitter with conventional antennas on the surface of Venus at a distance of 30 million miles. This suggests the feasibility of planning the radar for flyovers of comets in the planet.

Data obtained from the State University of Iowa's Venus orbiter in the period of 1971 to 1973 showed a wide variety of surface features. 11 km of topographic relief was observed. The data indicated that as soon as a new radar system, it is observed on and near the earth, it is visible, over the entire surface of the planet.

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Lower energy, probes in the 1-15 m. range appear to be highly con-

tinued in the near future of the radar system. Approximately 24-40 m. after the time, three of these look out from the main body, and are detected at high latitude and altitude. The radar system is a geosynchronous orbit in the earth's orbit, at the same level as the planet's orbit on the earth. The radar system is a geosynchronous orbit in the earth's orbit, at the same level as the planet's orbit on the earth.

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United Technology Corp. Awarded Contract for 120-in. Solid Motor

By Larry Woods

Washington—United Technology Corp., San Jose, Calif., a subsidiary of United Aircraft Corp., has won a contract for 120-in. solid propellant rocket motor for the Air Force to develop the 120-in. solid propellant rocket motor which is intended to serve as part of the main stage for a variety of rockets and boosters.

The 120-in. solid propellant rocket motor will be used by a variety of rockets and boosters. The 120-in. solid propellant rocket motor will be used by a variety of rockets and boosters. The 120-in. solid propellant rocket motor will be used by a variety of rockets and boosters.

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Data Indicates Centaur Structural Failure



CENTAU C-1 vehicle is boosted by NASA at Cape Canaveral and is engaged in tests (bottom) 55 sec. after normal lift-off and early flight. (bottom) 55 sec. after normal lift-off and early flight. (bottom) 55 sec. after normal lift-off and early flight.

Cape Canaveral-Pennsylvania Air Force Base, and on the 10th, the first flight. The 10th of National Aeronautics and Space Administration's Centaur C-1 vehicle indicated that a structural failure existed "in the area of the joint between the nose cone and the Centaur stage."

Catastrophe followed the failure, which occurred about 55 sec. after an apparently normal lift-off and early flight. NASA and the Air Force's Cape Canaveral and Sea Thruway "a more detailed analysis which is now going on at Cape Canaveral and Sea Thruway."

But there was some speculation of a possible cause in a few observers at the Cape and in the Centaur blockhouse. This suggested that one of the girthbolts, which are the Centaur stage—either one of the four cylindrical section interstage bolts or the liquid hydrogen tank, or one of the nose-cone bolts or its supports—had become detached prematurely and punctured a tank.

This was the sixth attempt to fly the Centaur vehicle, which is boosted by a modified General Dynamics/Air Force Atlas D intercontinental ballistic missile. Centaur stage which is similar to contractors to the Atlas series also is built by GD/A. It is powered by a pair of Pratt & Whitney RL10A-1 rocket engines developing 15,000 lb thrust each and burning liquid hydrogen and liquid oxygen (AV, Apr. 2, p. 52).

One major objective of the planned flight was to determine behavior of the liquid-hydrogen fuel under long-term storage conditions and during slow-down, re-ignition and re-ignition flight.

Centaur stage is 42 ft long, 10 ft in diameter and weighs 52,000 lb at separation. Forward portion of the stage is a gaseous-hydrogen core, made of two fuel cylinders and a cap, and weighing a total of 770 lb. Its purpose is to protect against atmospheric heating and to control the heat transfer from the nose section to the liquid hydrogen. This 15-ft long cone is designed to be jettisoned about three minutes after lift-off, released by explosive bolts and separated by the stage in two small hydrogen bottles. There are four pyrotechnic quarter panels of stainless steel around the hydrogen tank, between the base of the nose cone and the interstage separator. They are made of glass fiber having a plastic film with individual glass fibers. Panels are contained at the bottom by hinges and held with spring-loaded tension straps secured by ex-

MMRB Competition Target Date Scheduled

Oct. 11 is target date for submission of reports by the seven aerospace contractors who will be selected in Phase 1 of AFSC Ballistic Missile Defense competition for the mobile medium-range ballistic missile (MMRB) program being advanced by NATO nations.

Phase 1, a program definition phase, is the only portion of the program now funded. Proposals by the seven aerospace contractors are being received each day from beginning this month, and BMD probably will require 90 days to evaluate each proposal, which is expected to reach a final final price for the program definition phase.

Phase 2 proposals also will include a representative proposal for Phase 2 (development) based on a work statement which was attached to the requests for proposals issued earlier. From the Phase 1 contractors, BMD will select a group to undertake Phase 2. By Phase 1-4 it is expected that more than one contractor can be chosen to work together, but it is anticipated that only a single contractor will be tapped for each area of development in Phase 2.

The second phase will encompass design, fabrication, evaluation and operational tests and testing of a prototype system, as well as establishing a production potential for an operational system.

Phase 2 will provide accurate advantages, so that it will be possible for a contractor displaying superior performance to win a contract for use in the event of a major production, even so far and that he be held responsible for more costs.

Phase 3, covering the acquisition of the operational system, is not yet authorized by Department of Defense.

element bolts. The bolts were to have been removed by pyrotechnic means, releasing the parts in open air into the dispersion and pull away.

Removal of the launch and initial flight appeared completely normal to observers. Ignition of venoms, sustainer and booster engines was followed by a perfect lift-off. Programming down-range began at about 15 sec after the Atlas/Centaur lifted off the pad and appeared normal.

At 55 sec after lift-off, when the vehicle was between 18,000 and 30,000 ft, the failure occurred. The overall shape pattern of Atlas booster and sustainer were lost in a few seconds, which resulted in a burst.

On the last recovered piece of the Centaur wreckage, which hit in early flight, notes about three miles offshore over a sloping shelf which extends off the coast of the Cape. NASA said, however, that the nose-cone debris would not fall within a 100-mile radius of the launch failure. Some of the glass fiber covering burst in the nose-cone, on the left, but the rest of it was in a single piece in the nose cone.

X-15 Heating Reaches 1,250F During Flight

Edwards AFB, Calif.—Aerospace Heating (ASH) reached its first flight test, the 10th test flight, on Oct. 11, 1962. The 10th test flight reached 10,000 ft and reached 1,250F during the flight.

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temperatures, showed that temperatures on the lower wing surface and on the leading edge of the wing reached 900 to 1,000F. The flight was made at altitudes low (about 72,000 ft), but at high speed. Maximum speed was Mach 5.3 at 1,611 mph. Burn time was 59 sec. The total X-15 engine was 99 sec.

Maximum pressure reached by the atmosphere on the X-15 while in flight at Mach 5.3 was 3.67 psi, even though at 72,000 ft altitude. The ambient pressure was only 0.0001 psi at that altitude.

News Digest

Aerospace General Corp. has signed a \$17 million letter contract with the National Aeronautics and Space Administration for the design and development of the M1 engine, two or more of which will power the second stage of the New Heavy Lift Vehicle (NHLV) Apr. 16 p. 11. M1, burning liquid hydrogen and liquid oxygen, will develop 1.2 million lb of thrust and will heat 85 tons of the fuel in one minute.

Boeing's 444th space shuttle ground crew, which is the first flight test crew, the 10th test flight, on Oct. 11, 1962. The 10th test flight reached 10,000 ft and reached 1,250F during the flight.

Canadian Bristol Aircraft, Ltd., a joint venture subsidiary of Bristol Aircraft and the Bristol Aircraft Co. of Canada, Ltd., has been awarded for production of solid rocket propellant. A \$20-million contract for production of the solid rocket propellant is expected to be a significant step in the development of the solid rocket propellant.

From World Affairs and the Air Force Pilot's Air, not only agreed to be a contract with the major manufacturers and suppliers of the new equipment. The contract was signed in June to meet a threatened crisis. Details on the new equipment will be worked out after the contract is signed. The contract has been reached on some principles.

Col. Otto J. Glaser has been named as commander of the Air Force's Electronic Warfare School, "Hawthorne," 101st, Mass. Among the various, created when Maj. Gen. Charles H. Tordson, Jr., was elevated to BMD commander. Glaser, a command pilot has been named for his long career.

Dr. John L. McKee has been named Deputy Director of defense research and engineering technical warfare program. He was formerly president of High Speed, Inc. of State College, Pa. Dr. McKee, Jr., has been named deputy DOD research and defense systems. He was formerly director of all visual systems planning of North American Aviation, Inc.

First of two Mariner 8 spacecraft planned to fly by Venus will be launched around Aug. 30 from the Atlantic Mobile Range. U.S. will attempt another lunar impact with Ranger 5 about Nov. 14.

United Aircraft Corp. reported net income of \$4,587,183 during the first three months of 1962 compared with \$3,815,959 for the same quarter in 1961.

NASA Funds Cut

Washington—House Science and Astronautics Committee last week reported a bill authorizing \$3,940,000 for the National Aeronautics and Space Administration for fiscal 1963, representing a 10% reduction of \$44 million but an actual cut of \$10 million in the requested amount (AV, Apr. 16 p. 15).

The committee's report cuts only in the agency's facilities budget including the new launch pad complex at Cape Canaveral and in the scientific satellite program. The \$18.6 million requested for the Pioneer research satellite launch vehicle was cut and substantial new cuts in the scientific satellite program and other scientific satellite programs. The committee voted 97-12 to cut \$10 million from the agency's total \$44 million. It took from the research program the rest to go for land and facilities. The money, however, cannot be used for fiscal 1963 projects.

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CAB, FAA Challenged on Dulles Policies

Washington—Whether the Civil Aeronautics Board and Federal Aviation Agency are unfairly pressuring airlines to use Dulles Airport has become a central issue in House proceedings on a bill to establish a body to operate both Dulles and Washington National airports.

The issue erupted during recent hearings by the House Transportation and Commerce Subcommittee on two bills—one to establish an FAA-sponsored corporation to operate Dulles and Washington National and the other to create an independent board appointed by the President but not directly accountable to FAA.

The Kennedy Administration is backing the corporation bill. FAA Administrator N. E. Halsey and the committee would place the management of the two airports "in a sound business form" without draining the corporation from the revenues of the FAA. "It is a cost-benefit," he said in urging FAA cooperation. "It is an official of the corporation's board concerned with the balancing of various factors in a position to advise the Congress and the President that the airports are being operated in a manner consistent with the public interest."

Concern for Friendship

Backers of the real bill—sponsored by Rep. Donald B. Rosten (D-Md)—contended that FAA should not become involved in airport operations since this would conflict with its regulatory role. George Egan Jr., representing the Airport Board of Baltimore which owns Friendship International Airport, stated the case this way: "Does an airport have to be run in business form?" One of the goals of the sponsor of Dulles as new airport is to be an "airport business" and not a "airport government." The FAA might be too big to handle it, he said, but he is not going to be a victim of its dual and conflicting roles.

He also criticized BNA's operation of National, charging the agency let National become overcrowded rather than divert its traffic to Friendship.

Chairman John Bell Williams (D-Md) told Aviation Week that his subcommittee definitely will reject a bill this session, probably within the next few weeks. He called the Administration bill "the only practical approach." The Administration bill, with technical amendments, most likely will be the one reported.

The question of whether CAB and FAA pressed airlines to shift into using Dulles dominated hearings on the two bills. Rep. Samuel N. Frazier (D-Md) and he is "critical of what will happen [to Friendship International Air-

port] when Dulles opens, what FAA is going to do and what the CAB is going to do to shift traffic, which are all important issues."

He said the CAB's attention in these sessions toward Washington to land at Dulles is an example of using regulatory power to the detriment of Friendship.

Official Reasoning

Rep. Frazier's extensive questioning of Bond and Halsey about using their regulatory power for this purpose brought their answers during the House subcommittee hearings May 9, 10 and 11.

• **Bond:** The service to be provided by Dulles is going to be what the traffic demands. The fact that the airlines have reached an agreement with the FAA on landing fees at Dulles does not mean it is to land at Dulles, they are going to put the airlines where the business is. And if the marketing public wants to go in or out of Washington through Friendship, that is their business because they are going for the ride.

• **Halsey:** "Let me assure you that I have not said and will not say the airports, given that the Congress has approved in the office I hold to move the air traffic to do anything against their will. We are not trying to eliminate get flight at Friendship. We are trying to provide an additional airport at Chantilly. We, in the local government, are not going to determine the real whether or not the traffic demand is there at home."

FAA Permission

He added, however, that in trying to persuade airlines to use Dulles, "the normal natural tendency of a landlord to keep tenants will always prevail, but we certainly are not going to use our regulatory power to force the FAA to hold these against their will. The public is going to decide this in the end." Rep. Frazier noted one assumption of the bill: Friendship will not

have begun to make money. "We have to keep Friendship open, that's all that is in it," he said. "Dulles Airport 'is a white elephant and should never have been built and I am not in accord with it in any way, shape or form," Rep. Frazier added.

Halsey pointed out "in population expansion in a domestic continent, as the country gets better developed and more able to offer more productive services, more comfortable services, there is going to be need for Friendship, for Chantilly, for Washington National, for Belmont."

He said the opening of Dulles would be "a necessary, unfortunate byproduct" for Friendship.

Certificates Renewed For 3 Cargo Airlines

Washington—Civil Aeronautics Board last week renewed the certificates of Flying Tiger Line and Shik Airborne for an additional period and Republic Airfreight certificates for five years in ruling on the four-year-old Domestic Cargo Mail Service Case.

AAMCO Airfreight's applications for renewal were denied.

The order gave east-west authority to Flying Tiger and Shik—via north central and south central points (Dulles). Republic got north-south authority. All renewed certificates permit carriage of non-passenger mail.

AAMCO's certificate was not renewed because the carrier never raised rates on one of its two routes, and it applied requests from other carriers to balance its losses.

In a dissenting opinion, CAB members Glen Gernsey and Whitener Gilchrist said that should renewal of only one east-west service—Flying Tiger. Renewal of Shik's certificate would appear as an anomalous decision from Flying Tiger, they said. Both members favored no renewal for north-south cargo routes.

Friendship Finance Breakdown

Friendship International Airport opened July 23, 1970, and had revenue only just over \$400,000 the first year but already was Friendship. New Maryland officials said Friendship International Airport will take over much of traffic that Friendship will experience during open years.

Year	Revenue	Costs	Deficit
1970	\$470,035	\$481,796	-\$11,761
1971	566,617	663,249	-\$96,631
1972	531,015	723,298	-\$192,283
1973	590,045	786,045	-\$196,000
1974	1,267,074	896,708	\$370,366

* Data begins using Friendship as of 1970.

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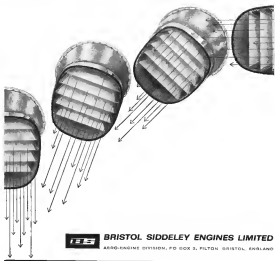
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Fokker Strives for 1966 F-28 Deliveries

By Cecil Browne

HEERLEN—Rene Netherland, Aeroflight Fokker hopes to gain foreign government approval for his company's first development and production of its two-engine short range jet transport project, the 44 to 60 passenger F-28 (AW May 7, p. 59).

Engineered primarily as a replacement for the Lockheed Tucano 700 series and the post-engine General 745-446, the F-28 is designed to operate economically over short distances as short as 300 mi. and as long as 1,000 mi. If a program of government financial assistance is forthcoming, its late summer, flight testing of the prototype could begin by early 1967 with five deliveries to customer airlines by late 1966 or early 1967 according to Fokker Commercial Director P. J. L. Diegen.

Wind tunnel model tests already have been completed under certain heading, but an estimated \$12 million in government aid will be needed to see the development through the prototype stage.

Orders Not Expected

Unlike the positive taken by some of its potential competitors in the short haul jet delivery market, Fokker says assurance of the development and production of the F-28 is not contingent upon having firm orders beforehand. Diegen adds, however, that a world-wide market survey recently completed indicates a substantial sales potential and that some airlines are actively considering the project as a replacement for the Viscount and Convair 440s being phased out in the late 1960s and early 1970s. Major competitors seen by Fokker there for at least some of its sales potential is the British Aircraft Corp.'s BAC 111 jet transport.

To gain added strength—figure of and political—Fokker also hopes to establish a European consortium development and production program for the F-28 along the same general lines as those of several North Atlantic Treaty Organiza-

tions, projects in which the Dutch firm is participating. Negotiations for possible partners are now under way with Britain's Hawker Siddeley Aviation, France's Sud Aviation and Germany's Messerschmitt-Bölkow-Blohm.

The straight wing aircraft, with an engine installed. Capable of 1,000 mi. on each side of the core fuselage, it is powered by either the Bristol Siddeley BS75 or a derived version of the Rolls-Royce Spey, both in the 5,000 lb. thrust class. By three engine Fokker says, will be capable of 52,000 lb. maximum gross weight takeoff at sea level from runways of under 5,000 ft. on each side. It is a two-engine transport with 15-16 seats, the aircraft, which has a maximum internal cabin diameter of 30 ft. 2½ in., can be configured to carry 60 passengers. Passenger facilities configuration provides for 44 passengers.

Adoptive of a straight wing also a recent wing design was decided upon in order to obtain maximum takeoff performance and to gain improved forward handling characteristics. Fokker considers the F-28 as its best cost-per-pound for short range operations and as the straight wing version could bring characteristics within this envelope. The wing also is smaller than a swept design of equal lift and is simpler and cheaper to build. It is said a control surface in the wing.

With the straight wing the company estimates the F-28 will be capable of entering from at least 55% of the sky in any direction, says Diegen (in DC-10) and Fokker F-27 transport.

Deeply experienced, however, that the F-28 is not designed primarily as an F-27 replacement and that the company, longer before enters the latter jet aircraft, including an STOL version in which development is complete will keep the new spec for the new four-engine version. One Fokker F-27 transport is being used in the U.S. already are being used by approximately 70 airlines.

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also hopes to be able to manufacture the aircraft's 700 without having to go to some remote, forest country. "That's to tell you we will under way, and no final decision is in its feasibility has been made."

To gain a full business capability, the F-28 will have a standard business power operated internal stair at its forward door, a single point pressure refueling system and an internal stair at its rear. Flaps will be of the Fowler type. Wing span is 77 ft. 7 in. and wing area 322 ft. 2 in.

Wing aspect ratio is 2.3 while the thickness/chord ratio is 12% at the wing root and 30% at the tip. Tip speed is 158. Forward fuselage door is 10 ft. high and 15 ft. wide. Window dimensions are 13.5 in. by 10 in.

Electra Noise Lures Starlings, FAA Says

Washington—Starlings fed the Lockheed Electra more attractive than other birds because it sounds like a "field of orchids," according to Federal Aviation Administration and Associated Research Institute.

In a report entitled "Acoustic Effects of Commercial Air Transport Sound on Birds," FAA concluded that the Electra produces an "audible" sound, a frequency and wave form to the effect of field orchids.

"These sounds should be eliminated or masked," FAA said. This might be accomplished by a change in the Electra's engine exhaust, the report suggests, or by the addition of inoperative exhaust to speed starlings.

For unknown reasons, the report said, some starlings tend to ignore sounds in the fall and cold and may stop singing. "Normal food sources—40% of the starlings' diet consists of insects—can be interrupted."

"It is understood that, under conditions such as those, a sound which simulates a field of orchids with singing orchids, would have a strong appeal for hungry starlings," the report said.

A Lockheed spokesman said, "It is a million years of speculation, there has been no report from any source in any observation of any attraction of the aircraft for birds."

In the fall of 1960, two major accidents occurred in which Electra engines ingested large numbers of starlings. One was a field accident at Boston and one at an airport in Ohio. "On other occasions," according to the report, "large flocks of starlings, gathering around electrical areas after engine starting, have forced the pilot to stop the engine."

F-28 Specifications	
Wing span	77 ft. 7 in.
Overall length	87 ft. 7 in.
Fuselage length	73 ft. 4 in.
Max. overall dia.	30 ft. 10 in.
Max. internal dia.	30 ft. 2½ in.
Cabin length	78 ft. 5 in.
Cruise speed	Mach .79
Max. gross weight	52,000 lb.
Empty weight	40,000 lb.
Fuel	9,000 lb.
Max. landing weight	47,500 lb.

F-27 Experience	
As of Jan. 1, 1965, the F-27 has been in service for 10 years and 10 months. It has a total of 10,000 flight hours and 10,000 landings. It has a total of 10,000 flight hours and 10,000 landings. It has a total of 10,000 flight hours and 10,000 landings.	

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AIRLINE OBSERVER

► **Hawaiian Airlines** press flight failed to assist H. Everett Clements, who has untied the airline's management for three years with inquiries into the company's efficiency, from membership on the board of directors. Reduction of board structure from 17 to 16 members failed to block Clements' bid for a seat but did prevent James A. Connel, HNL vice president, from being re-elected. Clements also was questioned as bringing Herb Wrenberg, board chairman of Honolulu-based Transit Co., onto the airline's board. Arthur D. Lewis, HNL president, is the principal figure opposing Clements, and has the support of 11 other management nominees who were re-elected to the board.

► **Airlines** are waking up to the fact that the long-awaited "breakthrough" in the air cargo field has already arrived. Steepers' interest in cargo is no freight is simply disappearing and carriers are beginning to salvage cargo sales and service efforts to handle the growing demand. With expanding fleets of all-cargo aircraft, freight and mail services will, for the first time, represent a significant portion of overall revenues this year.

► **Civilian Rule, Federal Aviation Agency's** newly appointed assistant administrator for approval, is expected to take a critical look at the relationship between the agency's Air Traffic Service and its Research and Development Service in one of his first big tasks in office. FAA Administrator N. E. Hilsbos has asked Rule to evaluate whether the agency's known and planned programs in the ATC area can be managed more effectively pending development and installation of the Project Business traffic control system.

► **Sen. George Smith** (D-Fla.) will introduce a bill soon calling for a mandatory 25-hour retirement for all active air traffic controllers.

► **Rose's** first transoceanic T-314C has recently completed their first test in scheduled service with an unimpeachable work record. The 170-passenger craft, which has been confined to the trans-Atlantic run between Moscow and Khabarovsk, made oak about 200 round trips in the 12-month period. The 60-70,000 passengers handled by the world's largest commercial transport in its first year of regular operation represented less than one-third of 1% of America's total passenger volume.

► **United Air Lines** and **Eastern Air Lines** pilots, who are petitioning FAA Administrator N. E. Hilsbos to permit the controller also allowed use of their companies' aircraft to occupy the same altitude over the same holding fix (AW 40, 10, 40), are being joined by pilots employed by other airlines serving the Washington area. More than 600 signatures had been collected last week, including those of the United and Eastern pilots involved in the May 21 incident.

► **United Air Lines** is testing use of fully automatic techniques to detect surface fires in metal parts, particularly in the region of the internal bore of bolt heads and shank of landing gear wheels. Defects are registered on a video banked up to a Wheatstone bridge.

► **FAA** is concerned, after evaluating Atlanta tower operation for about nine months, that the flow of traffic through an airport can be speeded if rules to meet and separate aircraft landing order about as well as instrument, flight rules. The agency is expected to publish guidelines that other U. S. main-occupied towers may wish to implement procedures similar to those pioneered in Atlanta.

► **Jordan Airlines Corp.** is showing strong interest in the Cascadia. Jordan government is now seeking about 100-150% on delivery and the balance repaid over a five- or seven-year period.

► **Alaska's** dependence on air transportation is graphically demonstrated by the fact that most points within the state generate passengers for its economy of their population. Prime example is Juneau, population 6,757, which had 116,075 out-going passengers in 1961. A total of 35,467 passengers flew from Anchorage, population 44,257. Even tiny Annette, with 387 persons, originated 27,649 passengers.

SHORTLINES

► **Allegheny Airlines** has ended Cool Air's route Board to approve a 17.5% weekend, round-trip fare cut on all routes. The reduced fare would apply between Indianapolis and 11-19 p.m. Sunday. Round-trip ticket would be good for 5 weekends after purchase.

► **British Overseas Airways Corp.** has experienced a 10% increase in passenger loadings since it began domestic scheduling Jan. 9 on its route New York, San Francisco and Honolulu to flights for Tokyo and Hong Kong.

► **Carl Alcock** Board has granted Northwest Airlines permission to discontinue its daily round-trip service between Baltimore and Pittsburgh, Cleveland and Detroit. Trans World Airlines was granted permission to reduce its two daily round-trip flights between Baltimore and Dayton and Columbus to one flight. CAB approved the route moves after consulting with the airlines on the poor traffic response.

► **Eastern Air Lines** has increased its "Air Commerce" service scheduling now allowing business passengers to fly as a point and return the same day by 105 daily flights between 25 major airports. Eastern reports a total of 530 air ports are now served by 975 daily Air Commerce schedules.

► **Federal Aviation Agency** will send 50 paid-over flyers to schools throughout the country for ground school and flight training as part of a \$175,000 program designed to acquaint them with the national aviation system. The program will be expanded later to include 100 FAA personnel. The program will take the student on their own first and will receive either a private or commercial license with instrument rating.

► **Japan Air Lines** has a new 55.5 million (2 billion yen) bond issue to buy DC-8, CV-580 and DC-7C aircraft and to repay its long-term loans to the Export-Import Bank of Washington D. C. The bonds are guaranteed by the Japanese government and are sold only in Japan.

► **Skydiving** enthusiasts may find themselves responsible for the safe conduct of non-emergency jumps under a proposed rule FAA is circulating. Last July, Administrator N. E. Hilsbos, persuaded from a helicopter to say, he said, whether such a rule was necessary and the agency reports the proposal follows his suggestion.



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In these new capacitors, in the full line of high-voltage units from 200 volts up, General Electric's experience in building foil Tantalum capacitors ensures unmatched reliability and performance. With the 450-volt units, for example, you get a close tolerance of ± 15 percent. And, after 2,000 hours, capacitance is at least 90 percent of rated value.

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The Beta Bolt... an excellent fastener for blind or close-out applications in wings, knees or other restricted structural areas. This 3-piece fastener assembly has excellent mechanical strength values, exceeds MIL Specs for vibration resistance because of its patented locking method and withstands repeated test levels to 160 doublets. Shanks are ground to insure uniform tightness in non-hole filling applications.

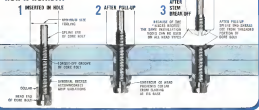
Three head styles are offered: an AN506 nut to permit direct substitution with similar headed blind fasteners, a conical disk for use in thin gauge material and a protruding style designed for maximum protection. Nominal shank diameters range from 5/32 thru 3/8 while a salvage series 1/64 sizes is also available. Gap lengths are in 1/16 increments with an additional built-in 1/32 gap for unexpected variations in work thickness. Beta Bolts are offered in alloy steel (150,000-300,000 psi

tensile) and A-286 configurations. Other Beta Bolt series in 7075-T6 aluminum alloy, titanium and other temperature sensitive and strength alloy are nearing the production stage.

Simple Adapter and Torque Driver tooling which assembled and fitted straight and 90° standard power screwdrivers, engage the unique "SIXCES" recess to install the Beta Bolt with a considerably less and load capacity by the operator than normally required to install conventional recessed bolts. Write for our new 4-page brochure describing the Beta Bolt: its strength characteristics, how it works and the installation methods used.

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how it works...



U. S. Airline Assets and Liabilities—Dec. 31, 1961

(In Thousands of Dollars)

	Total Fixed Assets	Less: Accumulated Depreciation	Property & Equipment	Total Assets on Liabilities	Total Current Liabilities	Long-Term Debt	Deferred Credits	Stockholder Equity
DOMESTIC TRAVEL								
American	191,457	48,310	143,147	419,332	108,457	212,712	42,872	155,293
Boeing	32,742	2,721	29,981	69,154	13,301	40,961	8,444	37,328
Caroline	1,458	42	1,401	2,107	392	38	1	1,476
Continental	16,991	9,104	48,704	77,112	16,323	22,467	2,948	35,197
Delta	21,424	2,213	105,392	146,744	39,347	48,918	10,440	41,917
Eastern	74,617	20,346	330,212	322,494	26,347	191,011	8,317	106,129
Northwest	7,444	1,004	1,204	2,212	301	1,704	1	1,904
Republic	20,129	14,734	40,794	68,468	20,730	38,007	4,274	35,263
Southwest	11,180	3,067	19,707	34,197	17,461	34,746	24	12,560
TWA	6,244	494	14,004	18,212	18,413	75,209	12,854	68,139
Trans World	14,109	2,719	39,404	52,449	8,712	12,528	174	14,800
Western	181,120	87,228	331,227	498,199	148,490	291,371	28,000	140,274
Alaska Pacific	140	140	140	140	1,264	1	1	1,263
Trans California	3,209	3,195	4,364	10,754	2,332	2,194	271	6,104
Trans World	114,920	77,385	384,481	496,499	10,612	212,712	12,205	171,369
Western	131,987	8,454	200,871	344,499	996,844	38,863	142,813	1,704
Western	31,484	7,140	61,553	82,162	14,304	26,141	3,119	18,817
Assets & Liabilities Total	921,493	203,347	3,271,340	5,475,299	1,719,940	2,196,940	248,448	140,427
SOCIAL SERVICE								
Allegany	4,200	3,044	11,093	17,138	4,474	9,433	153	3,228
Allegheny	2,408	310	6,791	9,491	3,100	4,347	267	2,227
Central	3,403	396	4,689	6,700	3,246	645	1	644
Frontier	2,720	140	4,006	7,181	3,181	1,837	13	2,148
Grain Central	1,610	1,012	4,092	7,204	3,814	2,387	1	2,482
Midwest	1,614	640	8,848	14,454	4,447	7,440	1	2,448
North Central	5,492	894	8,601	11,495	3,247	2,947	1	2,946
Omaha	2,408	1,008	2,115	4,549	3,294	1,222	1	1,199
Pacific	3,208	376	6,881	10,774	3,440	4,204	27	2,492
Pennsylvania	5,818	401	9,420	14,639	3,247	2,999	85	2,513
Portland	2,284	114	3,845	6,247	2,104	2,221	1	901
Rocky Mountain	1,237	267	3,329	4,849	3,069	1,747	43	1,236
West Coast	8,980	149	6,400	8,534	3,203	2,444	1	2,413
Local Total	62,838	4,828	171,175	239,999	44,480	88,120	433	37,101
ALASKA & HAWAIIAN								
Alaska Airlines	2,230	862	3,447	5,835	4,214	4,126	31	1,513
Alaska Central	1,822	142	3,209	5,179	4,414	1,773	1	470
Alaska Pacific	1,515	333	3,210	7,791	3,473	3,473	1	1,216
Continental	2,197	19	344	440	102	88	1	101
Delta	128	18	414	1,044	174	120	38	584
Frontier	1,444	818	3,213	6,446	1,723	3,748	28	1,704
Grain Central	1,111	95	128	320	73	73	1	147
Midwest	1,614	323	3,009	5,344	1,244	1,777	1	1,099
Pacific Northwest	2,444	704	6,228	9,410	4,634	88	327	3,521
Rocky Mountain	1,444	449	102	2,110	743	364	1	1,223
Western Alaska	1,111	142	142	142	142	142	1	141
West Coast	1,237	124	1,719	3,310	1,071	1,748	56	634
Assets & Liabilities Total	34,110	3,332	78,203	47,109	19,199	16,744	724	19,204
TELEVISIONS								
Chicago	1,110	41	891	4,108	298	2	44	1,411
Los Angeles	499	618	1,233	3,481	1,142	423	2	1,237
New York	1,144	1,233	3,414	5,644	140	140	182	2,308
Assets & Liabilities Total	3,753	5,144	5,539	9,133	3,279	583	661	6,624
CANADIAN CITIES								
AMCO	1,127	1	2,319	4,327	1,019	500	108	3,120
Allegheny	478	49	344	793	480	111	27	115
Boeing	1,127	1	198	447	198	27	1	19
Continental	12,318	54,137	38,430	46,772	12,318	40,448	1,491	11,220
Delta	1,127	1,237	20,099	30,114	14,078	13,468	10	648
Frontier	4,201	4,201	20,138	28,269	7,714	24,750	1,702	2,844
Grain Central	4,201	4,201	20,138	28,269	3,192	8,032	16	2,444
Assets & Liabilities Total	36,488	20,180	103,799	185,988	37,898	74,718	5,838	25,594
Assets & Liabilities Total	100,638	244,524	3,474,728	5,616,386	2,042,427	2,400,280	264,987	161,021

1 As of Sept. 30, 1961.

2 Preliminary figures.



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Increases in Airline Operating Revenues

TABLE 1961 OVER 1960 (in thousands of dollars)

	PASSENGERS (thousands)				TOTAL OPERATING REVENUE			
	1960		1961		1960		1961	
	Actual		Increase or (Decrease)		Actual		Increase or (Decrease)	
DOMESTIC TRUNKS								
American	327,567	357,429	30,862	9%	421,452	454,432	32,980	8%
East	48,864	70,569	21,705	4%	74,785	107,496	32,711	4%
Continental	56,734	56,253	(481)	0%	41,248	37,999	(3,249)	-8%
Delta	117,881	141,193	23,312	20%	128,374	162,343	33,969	26%
Eastern	345,482	343,627	(1,855)	0%	243,794	261,519	17,725	7%
National	88,984	88,569	(415)	0%	64,476	74,212	9,736	15%
Northwest	15,364	16,251	887	6%	37,221	37,129	(92)	0%
Republic	75,384	67,125	(8,259)	-11%	77,844	77,944	100	0%
TWA World	121,641	245,276	123,635	101%	107,118	179,448	72,330	68%
United Capital	492,151	488,811	(3,340)	-1%	307,118	317,377	10,259	3%
Western	35,774	34,102	(1,672)	-5%	66,247	57,141	(9,106)	-14%
Total	2,716,048	2,716,048	0	0%	1,048,452	1,070,548	22,096	2%
INTERNATIONAL								
American	5,610	5,227	(383)	-7%	8,311	8,311	0	0%
East	9,231	9,151	(80)	-1%	10,410	11,792	1,382	13%
Continental	3,209	3,406	197	6%	3,209	4,000	791	25%
Delta	2,974	3,113	139	5%	3,384	3,432	48	1%
Eastern	27,107	30,149	3,042	11%	36,056	35,091	(965)	-3%
National	1,491	1,491	0	0%	1,414	1,711	297	21%
Northwest	1,203	1,203	0	0%	1,203	1,203	0	0%
Republic	20,084	23,756	3,672	18%	20,084	20,184	100	0%
TWA World	14,739	14,111	(628)	-4%	19,198	18,811	(387)	-2%
United Capital	316,268	303,842	(12,426)	-4%	415,794	428,024	12,230	3%
Western	23	23	0	0%	23	181	158	687%
Total	434	418	(16)	-4%	624	640	16	3%
LOCAL SERVICE								
American	9,109	12,612	3,503	38%	14,418	20,002	5,584	39%
Continental	4,543	5,499	956	21%	5,207	7,121	1,914	37%
Delta	3,454	4,075	621	18%	4,075	5,075	1,000	25%
Eastern	4,263	5,214	951	22%	14,418	14,418	0	0%
Northwest	4,543	5,499	956	21%	5,207	7,121	1,914	37%
Republic	12,612	12,612	0	0%	12,612	12,612	0	0%
TWA World	12,612	12,612	0	0%	12,612	12,612	0	0%
United Capital	7,121	8,271	1,150	16%	12,612	12,612	0	0%
Western	4,184	4,184	0	0%	4,184	4,184	0	0%
Total	7,118	8,271	1,153	16%	12,612	12,612	0	0%
Local Total	48,864	56,253	7,389	15%	146,442	177,004	30,562	21%
ALASKA & HAWAIIAN								
American	3,323	3,323	0	0%	3,323	3,323	0	0%
Delta	1,012	1,012	0	0%	1,012	1,012	0	0%
Eastern	4,494	4,494	0	0%	4,494	4,494	0	0%
Continental	103	103	0	0%	1,344	1,344	0	0%
National	718	718	0	0%	1,344	1,344	0	0%
Northwest	4,494	4,494	0	0%	1,344	1,344	0	0%
Republic	6,189	6,189	0	0%	1,344	1,344	0	0%
TWA World	1,344	1,344	0	0%	1,344	1,344	0	0%
United Capital	7,201	7,201	0	0%	1,344	1,344	0	0%
Western	1,344	1,344	0	0%	1,344	1,344	0	0%
Alaska & Hawaiian Total	35,774	34,102	(1,672)	-5%	50,000	50,000	0	0%
HELICOPTERS								
Chicago	1,012	1,012	0	0%	1,012	1,012	0	0%
Los Angeles	201	201	0	0%	1,012	1,012	0	0%
New York	1,012	1,012	0	0%	1,012	1,012	0	0%
Helicopter Total	3,025	3,025	0	0%	3,025	3,025	0	0%
CARGO & OTHERS								
American	271	428	157	58%	2,182	2,182	0	0%
Continental	271	428	157	58%	2,182	2,182	0	0%
Delta	271	428	157	58%	2,182	2,182	0	0%
Eastern	271	428	157	58%	2,182	2,182	0	0%
Northwest	271	428	157	58%	2,182	2,182	0	0%
Republic	271	428	157	58%	2,182	2,182	0	0%
TWA World	271	428	157	58%	2,182	2,182	0	0%
United Capital	271	428	157	58%	2,182	2,182	0	0%
Western	271	428	157	58%	2,182	2,182	0	0%
Cargo, etc. Total	271	428	157	58%	2,182	2,182	0	0%



LOCKHEED proposed for a VTOL version of the F104 has 14 Rolls-Royce RB171 jet engines, seven in each wing pod, equipped with eight nozzles (AW Dec. 18 p. 74). Forward thrust would be supplied by a Rolls-Royce RB182, a four engine with afterburner.

German Resurgence Revealed at Hanover

By Cecil Brownlee

Hannover, West Germany—Bidding re-construction of West German industry, as a joint design development and production force in both civil and military fields plus the intense under-the-surface struggle among rivals in the North Atlantic Treaty Organization strike fighter competition was in evidence at the 1987 Hannover Air Show which closed here last week.

Scope of German interest and design work on duplex ranged in concept from plans for a 26-passenger helicopter with a 500 mph cruise speed to radiance of competing proposals for the potential dual stage of the booster system for the European common space program.

Actual hardware inside the business-filing field was slow but plans for production on all levels were evident at almost every static exhibit.

Signs that the World Commerce industry has taken all its previous warning periods and now is ready to stop further signs with original designs and production reducing VTOL aircraft the way is credible. Speculation over the outcome of NATO's VTOL BMR 51 strike fighter competition was heightened by the announcement of a defence pact between the United States and the United Kingdom. Affairs where political leaders are seen as part of national design efforts are expected to be active. The recent announcement by Defense Secretary Robert McNamara in London that the US government plans to allocate \$18 million for continued development of the British Suddon F1127 tactical fighter, the British Aerospace BS 535 (widely known as the Sidewinder) and the range of their production.

United States central economic growth.

project is male concentrated has much to do with the development of the BS67, which is scheduled to enter drug stores first of 1980 to its production (around 100,000) and the 74,800-125 BS180 follow-on were due to expire in 1980, and officials here are the new prototype should allow the P1137 to complete its development in 1980, and then to enter drug stores. While the transverse P1137 is a new entry in the NATO competition, from the second and the apparent United States decision to continue support of the variable-thrust concept is opposed to independent left engine on combat aircraft could come either the Mach 2 P1137 follow-on or the Republic F-16 (F-16A) which generated a new version of the BS108 in a relatively short-term position.

West German designs for VTOL combat aircraft, including the Focke-Wulf 1262 and VJ 101 under development, Messerschmitt, Heinkel and Bf 109 were not chosen.

Porsche-Wulf, however, did display a model of a large VTOL transport designated the JW 260 with two wing pods, each housing an 800-hp engine.

Planned lift engine, should the FV 265 be placed into production, is reported to be the General Dynamics SS 9 turbofan. Prototype of the 5,000-lb thrust SS 9 is scheduled to begin testing later this year. Other General Dynamics engines were recently selected

• Blockage of competing third stage booster units, one dropped by Bolkow-Eurokings and another in the Northern Industri Group composed of Focke-Wulf, Hubschwer Flugzeugbau and Wesflug. West German governments, with responsibility for providing third stage for European space booster, is expected to make a decision between the two in the near future.

Bilken, designs a bond upon an advanced economic fact system.

* **Fixed-Bed Helium Helicopters**—Intending a planned 20-passenger vehicle with a design speed of 180 mph. Noted features designed to permit attainment of relatively high speeds in water without on which blades lost and big theoretical problems in test as possible (AEC, Mar. 12, p. 247). Power for horizontal flight would be supplied in two 2,500 hp General Electric T80 engines, one located on either side of fuselage. Experimental two place helicopter to test blade water concept is under construction and scheduled to begin flights next September.

• **Model of Hendrick's 211B1** (aeroculture, short trap, transport proposal) (AW Apr 30, p. 41) Actual production will depend upon receipt of firm orders for at least 20 to 25 yards.

• **Hawker** *Phantom*'s HFB-120 bi-jet fighter aircraft prototype is under construction and Hawker *Phantom* is based on a substantial



SOURCE MODEL shows general configuration of a furnace but which can model one furnace under government constraint to evaluate the firm's high speed holding rate concept



POSSIBLE SIX-BLADED 26-passenger helo on its to the Bellini test which includes a small jet engine on either side of the fuselage to aid in accelerated flight. Cruising speed for the turbine-powered helicopter would be approximately 130 mph.



TWO-PLACE close-based helicopter with a rigid rotor head system under development by Bellini, with private funds is scheduled to sell for about \$22,000 when it reaches the cross-country market. Designated BO-101 the helicopter is to be powered by a NSU 0-400-01 turbine combustion engine with a maximum rating of 190 hp.



WING TRANSPORT MODEL on Kolls-Royce stand (above) demonstrates the British firm's approach toward selected flight for heavy loads where lift engines alone are insufficient. Four lift engines positioned in two wing pods are augmented by two turbofan hot thrust engines under each wing modified to take dedicated thrust nozzles (AW Sept. 15, p. 38). Cleanup of Rolls delivered these engine assemblies (below) shows one potential approach under study, with the pole-mounted nozzle swept crisscross downward to represent the lift engines in vertical field.





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West German air force order for use in a supersonic trainer.

• Domestic display emphasizing its work on space projects including Rapidia wing design. Dornier is building a new space research facility and reportedly will play a major role in future West German projects in this field. Dornier also is building a VTOL transport on a Defense Ministry order using a BS 51 joint design each wing.

Hawker Siddeley hopes to sell production quantities of the P 1127 instead of the P 1150, as opposed to the 1965 date for the advanced P 1150. Operational schedules for other models in the NATO competition are comparable with that for the P 1150. Powered by a scaled down version of the 18,000 lb. thrust RS 100, the P 1150 has swept wing and then streamlined fuselage but still bears a family resemblance to the earlier P 1127.

The Republic F-105 can be swept into the NATO competition.

The Republic F-105 can be swept into the NATO competition.



SOLIDW HODDER of dual-ring booster for the European common space program represents a design which would have a Russian propulsion system.



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Rolls-Royce DB-35, No. 3500 Series

POSITIVE THIRD STAGE for the planned booster vehicle for the common European space program, the Black Arrow, is under development by British Aerospace. Below design, based around a boost-press package, is competing with a parallel project sponsored by the German Southern Group of industries for a West German government development contract. Three stage model was displayed by British Aerospace at the Hannover Air Show.

is powered by the fully-rated RS100. The RS100's sole power chamber burning on the two forward nozzles, while the third is thrust from the forward in the vertical is limited to speeds of Mach 1.2 at sea level but can reach Mach 2.5 at altitude.

In order to attain lower specific fuel consumption at high speeds and low altitudes the powerplant uses a higher compression ratio and lower bypass ratio than an RS100 predecessor. Both engine designs will be equipped for water injection into the combustion chamber to increase the problem of thrust reduction during takeoff under high ambient temperature conditions or from sites located high above sea level.

The Lockheed Star included a model of the proposed V700, a version of the F-104C designated the CL-704. The aircraft, with seven Rolls-Royce RB151 lift engines in each of two wingtip pods was submitted to the NATO concept team as a joint entry with Short Brothers & Harland. Lockheed also is developing its sole campaign towards individual European nations scheduled to receive the F-104. Aside from wingtip pod design changes from standard F-104C configurations, including a reduction of higher thrust, more conventional Rolls-Royce RB109R, a scaled down version of the Spey, a main powerplant in place of the General Electric J79, bolting of the aircraft's structural strength including a new wing box beam and tip fillet and pitch control cone configurations.

Present aircraft models could be retrofitted to fit the V700, not. Each engine pod has a fuel cell in front of the engine tank and another behind it with the in-betweening roughly the same capacity as the top tank used on present F-104 models. Lockheed officials say the aircraft can meet all the requirements for range and speed laid down in NATO specifications. NATO specifications stipulate that the aircraft must be capable of an air to air speed of Mach 9 for a range of at least 700 mi.

Design concept for the NATO entry, a new version of the Fiat CRJ designated the CRJ-6 also was on display. A Mach 2.5 design the aircraft would use two conventional turbojets with advanced thrust capability for forward flight, plus two boost-press lift engines, three in front of the engine and another three behind for VTOL flight.

The Rolls-Royce plant also included models of a delta-wing concept designed to augment on each of 141 engines in large aircraft designs incorporating a nozzling mode to provide the vertical thrust. Engine was included on at least one entry submitted in NATO competition for a medium-range VTOL transport. Initial study was based upon a scaled down Spey of 8,000 lb dry thrust, designated the RB151.



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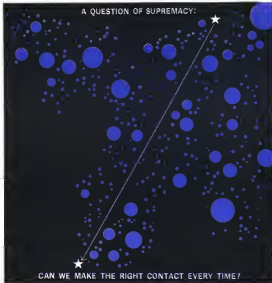
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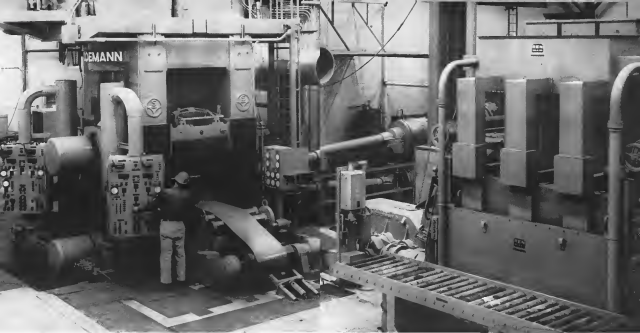
F-27 Capabilities Expanded for Military Missions

Turboprop-driven F-27 has been awarded Federal Aviation Agency certification for a higher altitude single and wing fuel dump system. Turboprop officials said that the F-27C military version, designed for short-range fast personnel transportation with take-off at 0.800 ft/sec with a 22,000 lb. payload over a 50 ft. obstacle in less than 3,750 ft.

The aircraft manufacturer currently is building 11 F-27s for 12 airlines and 10 military corporations.

The F-27C will be demonstrated to military officials this month and in June, according to the company. The interior configuration of the aircraft permits conversion for medical evacuation missions after design is downloaded. Large wing doors are a crash height for cabin loading.





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THE DU PONT METALS CENTER



Editor: Douglas for Bulletin Publishing — Through Chemistry



STANDARD EQUIPMENT: HUGHES TONOTRON STORAGE TUBES

Shepard-as-all strategists, using Hughes TONOTRON® storage tubes in the Navy's new Naval Tactical Data System, can now predict enemy moves with uncanny precision. They can watch every move of his aircraft, ships and submarines in a combat area and follow the tactical situation second by second as it unfolds.

Key component in the NTDS is the Hughes TONOTRON storage tube. This direct view tube accurately displays up-to-the-minute information even under difficult ambient light conditions. Its controllable persistence permits high resolution, full-frame displays to be stored for delayed study—or erased instantaneously!

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Direct view storage tube. Quality design, rugged construction, and precision manufacturing.

telling in a moment's moment of flight, as my comrades were during the flight control mission and I knew each of them personally. Further, voice-actuated my strength and speed, enabling me to make the most accurate measurements of my comrades' progress. I knew that my comrades, who had all flight data at their disposal, were able to give me help at any moment. And as a bonus of my guidance, I made out-cries for some of them when I was sighted and told them what I saw in the cockpit.

Flight training at this period included fights to experience weaknesses and rehearsal of pre-learned tactics while carrying a complete set of radar equipment, i.e., the space suit and portable emergency supply with communication devices and also food.

Physical training and medical supervision of my health were planned as a year-around basis. Inactive and physical training enabled me to build the flight program more easily.

Now I am going to give a couple of words about the spaceship Vostok-1 and about the mission of it.

The spaceship Vostok-1 is a considerable rocket apparatus. Its weight, with all the fuel stage of the booster is 730 kg.

Six Engines

The ship itself was put into orbit by a multistage booster having six liquid-fuel rocket engines of the Vostok type. Total maximum thrust of the engines of all stages is 600,000 kg.

After separation of the booster last stage, the capsule movement, compartment and isolation installation arrangement remained to orbit. The interior surface of the capsule is covered with a layer of heat shield to protect its operation in high temperatures. For electric power the capsule had two batteries.

The ship's cabin is equipped with an optical installation designed for determination of the local horizon and heading. The cabin incorporates the space life-supporting system, including the air-conditioning system, pressure-regulating system, food and water, the system designed for disposal of excrement products.

Food water, engineering plant solutions, electric power supplies were arranged for supporting the mission for 30 days. Apart from these, the ship is provided with the radio equipment for ship-to-ship control, the equipment for observing and recording physiological functions in flight, radio-telemetry equipment, independent tracking system and transmitter component for controlling and recording ship equipment operation in flight.

The ship's cabin is equipped with a television camera for observing the mission and a camera movie camera the thermographic camera and the cathode.

After the introduction here of the air-conditioning compartment separated from the capsule.

The cabin and the compartment's work plan. Its design provides for the reduction of a number of functions connected with the possibility of a long stay in the ship's cabin. Besides, the unit provides for operation in case of emergency. On command, it is possible to parachute, and contains all that is necessary for sustaining the

mission after landing. It has necessary air, food and oxygen supplies, etc. The unit is equipped with an inflatable dinghy which deploys automatically if descent is to be achieved.

All the equipment complex in conjunction with the gear met the commander's life in any climate and geographical conditions.

Many of you know that all this was recorded within by Gagarin during the first flight and by me in both crew flights, was recorded precisely in a given area.

Manual Control

Apart from the automatic which is complete fulfillment of the whole program of flight, the ship is provided with manual control for almost all of the system. The command is able to control the ship in the air in most cases, to open, to adjust the cabin's atmosphere parameters, to fix the instruments, i.e., to hold the ship, starting from any orbit in any chosen area.

The conditions inherent for man were strictly maintained in the cabin. Therefore, though I was in a space suit, the two feet of the space helmet was kept open almost all throughout the flight.

The landing of the ship took place at 9 o'clock, Moscow time, on Aug. 6, 1961, from the balcony (Kondratyev) command post. The landing was completed at 10:30 km 15 min on Aug. 7, 1961, near the settlement of Krasny Kamen (Krasnoyarsk). The flight lasted 25 hr, 11 min. The ship's weight was 170 kg, its speed was 240 km. The ship's plane was in 64 deg. 55 min inclination to the equator. The ship made more than 17 turns around the earth. The ship's period was 83.45 min.

The flight was proceeding in the following order:

On taking for orbit, the spaceship appeared from the horizon and large Vostok program, which I shall discuss later, was carried out during 17 orbits. At the seventeenth turn, the automatic device controlling the ship's orientation and speed system was switched on. After every six turns the earth's shadow the ship was situated in the sun and at a definite moment the parachute fell. Then the ship fell into the capsule and the automatic compensated.

On controlling the atmosphere and down the capsule down, at 6,500 m (16,000 ft) and 280 m per sec, at descent, the system took place followed by parachute descent.

Personal Impressions

This was the general outline of the flight. Now I would like to tell you about my personal impressions, my spirit, and about everything I saw, beginning from the moment I entered the cockpit up till the landing.

Strict duty routine was fully occupied with preparation for flight, manual conditions of work, rest and diet told me the spirit's condition. I was in high spirits, never lost confidence in a successful launch, my flight and landing.

The first try to the landing into the water was successful, without any delay, without any trouble, it was felt that all was at their places and acted efficiently and



compact your control system



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Army scores significant aviation first:



"Hands off" ILS approaches for helicopters

A major advance in utility and performance of rotary-wing aircraft—fully automatic instrument landing approaches—has been achieved by the U.S. Army and Sperry Phoenix Company. This is the latest in a series of important Army Sperry achievements in automatic flight.

A twin rotor Army HO4S Shawnee, equipped with the 55-pound Universal Automatic Flight Control System developed by Sperry with the U.S. Army Signal Research and Development Laboratory, has made "inmate" ILS approaches. The system took over and guided the complex five-course navigation of the aircraft even though

critical rotor speed. Automatic approaches were made in an altitude of 50 feet—well below established weather minimums. This advance is a key step in solving traffic control and other problems of automatic helicopter operation.

The Army Sperry system also "inmates" the helicopter to the network VORT ground data network for automatic enroute navigation. Designated the AN/ASW-12 (V) system, it can provide precise automatic control for many types of Army aircraft, both present and future. Designed around a general 400-pound computer-instrument (a self-contained servo system) it offers a

variety of combinations "packages" to achieve any desired degree of flight automation.

Mark satisfactory results reported in earlier trials, the new system is in production for the G-100 series AG-100, HC-119 Chinook, and HO-4S helicopters. As an example of precision landing approach performance, the system has guided the Chinook to the goals of touchdowns under automatic control.

SPERRY

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simultaneously, all this created a very good experience and kept up constant optimism and mood.

While in the net, I peeled from all sorts of scenes coming through the binoculars. I felt that the last preparations were in progress, and I maintained communication with the control tower. After some time the command "Abandon ship" was given. The binoculars began moving upward very smoothly and all went as planned during the first seconds. Comfortably the speed began to build up which was felt through an increasing stream. Vibration was unpleasant. Vision was not obscured, landing was easy and satisfactory. Binoculars slipped out of one after another. This could be detected through vibration of nose and globe. Radio contact with the ground was maintained continuously. I ignored about my condition and about the binocular operation. After the last tag was released, I could see the earth for the first time from a very good altitude. The speed of the drop was still increasing.

Suddenly the nose dropped, vision fell and I had the sensation that I was entering a head-down posture. The objects that surrounded me seemed to float up, and only one or two seconds later they returned to their places.

The last stage around the earth began. I pulled off my gloves, opened the binoculars and checked the equipment, glancing at the earth through the porthole. The earth was very noticeable. I turned the vision on. The first thing I heard was an odd, though still unknown to me, sound, rather like a low hum. At this time I was informed by earth that the cubic feet, space craft Vostok-2 was just into view close to the celestial sea.

On entering the earth's shadow, I noticed that on immediately my planet seemed to be dark gray. The horizon very visible at the time I was in the shadow. It looked like a heavily textured, jagged edge. While emerging from the shadow I watched the dark gray, then blue, darker purple band at the very earth and black earth. Incidentally, of one look at the earth from a lighted angle which revealed in the earth's shadow, our planet does not give the impression of a black spot. The earth appears to be covered by a gray sheet. And what is more if you look at it more attentively you can even see the earth sun.

On emerging from the shadow, I began to realize the ship manually. The ship could respond to my handling of the controls, and after several minutes it was controlled completely.

Just at this time, Vostok-2 was approaching the orbit of Aphelion. Aphelion was close of course. Yellow and brown bands were quite distinct. The blackness of shadow was clearly against the background. The clouds, however, began to grow gradually and soon it became difficult to see anything on earth. I got hold of a more intense and took pictures of the earth's cloud envelope.

As stipulated in the program, during the whole flight I maintained balanced communication with the ground, oriented myself and self-observation, carried out physiological and psychological tests. No breakdown was detected.

The first turn passed then the second. When the drop was in its third orbit, i.e., 1 to 42 m after launching, I had almost

The first of the drop occurred in space was gradually the same as of those entering the ground. However, the cosmic background was a certain touch. While opening a tube, containing black-cosmic space. I pulled a drop of the liquid, which was suspended in front of my nose, and I had to look at it.

After about 10 minutes the time for sleep entering and emerging from the earth's shadow. According to my calculations the period was 1 to 20 min, and on the next orbit it was 1 to 30 min.

In the fifth orbit I repeated the psychological tests again. On the sixth turn I was in radio communication with the earth to avoid. I reported that the air conditioning equipment was operating perfectly. The temperature

was 20.21 deg. C, relative humidity 70%. At 17 hours Moscow time, while in the seventh orbit, I had my supper. When I was flying over the Gulf of Mexico, I was fascinated by the beautiful pale green color of the coastal waters which further were changing into a greenish yellow color of the sea. While flying over Washington, the capital of the United States of America, and seeing my first regards to the American people, I thought that after several minutes I could be living over the capital of the United States Socialist Republic.

I covered the distance between Washington and Moscow in only 15 min, the first time in human history. Cosmic space brought me into closer contact with the earth.


In this orbit I had several minutes in



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This newest AO Hear-Guard, a lightweight, impact-resistant, soft-type hearing protector, has been engineered for maximum effectiveness. With its scientifically designed cups—designed on the basis of human engineering studies—and wide adjustment range, an excellent fit is provided and hearing organs are effectively protected from damaging noise.

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took upon, and after trying the various removal arrangements, I started by good first again and started to prepare for sleep. Maybe I should not have waited so much actually awake, as I felt a certain discomfort under the first symptoms of sleep.

It was merely felt during sleep most of the head, though this sensation did not affect my efficiency.

Before coming on I felt of all kind my head which seemed to be extended in the air and felt some light dizziness. At first my sleep was not sound enough. But then I kept the sleep of the past and spent. It was more so it then changed in the program. My sleep was good, without dizziness, a comfortable in each confidence. I didn't feel the necessity of turning from side to side.

Having remained in the darkness and not feeling the cold signals of a calm sleep, I didn't understand at first what was going on, but then I noticed something at once and began to nibble into comfort. After discussing the coordinates and reading them in each. I found that I had used well and that the unpleasant sensation of discomfort had faded.

When I was being over South America and approximately over the Atlantic Coast of Brazil, I detected low atmospheric pressure in the dark of night. They were apparently the light of day. The clouds passed me from being there in front in the course of the night. I had the opportunity to see my mountain satellite—Guatemala—on these times. Outside the atmosphere it looks much more distinct otherwise it is the same as when we look at it from the earth. As by the stars they seemed to be brighter, and there was some of the twinkling as we so much accustomed to.

When I was being over the South Ocean I saw real stretches of colored land.

Thus, an unusual sleep of the earth and following equipment experienced by the

program is taking in the earth's shadow at another. I started the first month, first month and second month.

In the second month I started to prepare for the descent. I made some of the objects I had used in flight checked the several equipment prepared the space suit. The various arrangements which provided for sleeping and descent to the ground was checked on.

At 8 in 12 was the atmospheric installation out in a rocketing way. It felt through the nose, through compression of the respiratory conditions and through blood pressure. Something that looked like snow was passing in front of the port hole. From after it looked like frost on the ground and the ground ended open.

Cold weather had a welcome effect upon me after because the atmospheric condition of stress had disappeared in favor of the fact that I was returning to earth.

From after coming, though walking somewhat the respiratory which demands closure of the particles during descent, I felt the particles open and was revealed that the dense time atmosphere is only with a light exposure person of a very people time exposed. The particles began to turn white, the glass acquired a blue color.

Cloud started to increase. My body weight experienced several times. Nevertheless, some was not disturbed, breathing, though somewhat heavier—critical again, deep and slow. Cloud started to show gradually. The sound reaching the nose of a jet engine reached my nose. The sky was everywhere approaching the earth.

The last few minutes device dark, followed by capture. Several seconds later I began travel on the three bars. I took in fast feeling, spreading below, clouds of light. I saw a column and a line that appeared as though stuck on the side a round two big circles in the distance.

The ground came nearer and nearer. It seems that I was going to land close to



Nimbus Control Station Fabricated

Ground station for Nimbus weather satellite essential control station will store satellite information transmit them in satellite pass overhead and is designed for mobile or fixed development. Station includes all decoding equipment. Three ground stations and seven satellite-borne stations, comprising 16-18 and consisting of electric and conditioning elements capable of controlling 120 satellite devices in the satellite are being fabricated by Colorado Computer Products, Inc., Denver, Calif., for NASA.

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Hamilton Standard White Room being used on assembly line check-out propellant transfer carts for the Air Force Titan II missile program. This facility is completely available for test and assembly of systems and components which must be protected under extremely clean conditions.

White room for the Titan II propellant transfer system

Development and production of equipment for handling extremely volatile solids such as the propellant transfer unit for Martin Marietta Corporation's Titan II—demands a contamination-free environment, controlled to within 0.3 micron. Hamilton Standard's new White Room, especially designed for building missile fuel handling systems, even surpasses the existing requirements of a hospital operating room. It provides 900 square feet of ultra-modern assembly and testing equipment. Detailed construction care and strict control procedures will maintain immaculate conditions always.

Building a propellant transfer unit for the Air Force Titan II missile program is just one of several major GSE projects in which extreme cleanliness has been a major consideration. This package will be skid mounted, electrically powered, remotely controlled (with auto-

matic safety), and capable of pumping either fuel or oxidizer. Performance is measured by its ability to absolutely contain toxic fluids and vapors. To meet these requirements, Hamilton Standard developed important new concepts in sealing and system reliability.

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the relief. I touched the ground with my head and arms but it was not the light I was expecting.

Flight Results

And now, with our previous flight data, the results of this flight. During the flight my organism was in an constant medical observation.

Ground stations received information from the ship on my condition and recorded my head beat and breathing. Electrocardiography was effected as a continuous basis.

The medical observation results indicate that the organism adapts rapidly to the ever-changing conditions of space flight.

From the point of issue of our suits tires and physicians, the recorded vibrations of the organism's physiological functions underwent well to those in land stresses caused by the flight. i.e., they were adaptive.

Thus, if one observed the pulse condition, one noticed that its rate prior to boarding the ship was 72 beats a minute. Five minutes before boarding, the pulse increased to 165 beats. This actually is only expected. Undoubtedly we must permit the organism longer time, the needed "pre-boarding state."

To my mind it is significant that at the same stage of the flight, at the maximum of the acceleration effects, the pulse which read by only 16 beats, it increased from 105 to 114 beats at the beginning of the stage, and then returned to 87 beats when the ship was being put into orbit.

When the ship was descending the pulse was at 105.

As the flight progressed, the pulse rate

New Radiation Theory

Washington-Pennsylvania analysis of data from the Explorer 32 satellite indicates that, contrary to former theory, the frequency of ionospheric space ionizing solar radiation plasma is at least 10,000 to 50,000 km, beyond the limits of the earth's magnetic field, with this ionization region being non-reflective. This qualitative conclusion is based on measurements at altitudes up to approximately 77,000 km, at lower than the satellite position, with energy levels less than 20 eV per space ionization per second. This is the first time previous theory had indicated.

The satellite also failed to find the predicted large area current of electrons at distances of 40,000 to 100,000 km. Michel Bader of the National Association of Space Astronautics reported here at a recent meeting of the American Astronautical Society. New hypotheses were proposed to explain the large ionospheric region suggests a new model from ionospheric by solar particles of an existing interplanetary magnetic field of enormous region or of a highly disturbed solar field. Future experiments about satellites with higher speeds than the Explorer 32 are expected to provide additional clarification, Bader said.

SWEDEN AND NORWAY CHOOSE SELENIA ATCR-2 AIR TRAFFIC CONTROL RADAR



After a detailed analysis of competitive radars by the technical and operational experts of Sweden and Norway, SELENIA radars were chosen. SELENIA ATCR-2 dual-channel air traffic control radars are to be installed at Stockholm (Bromma) and Oslo (Fornebu) airports. These radars are ideally suited for coping with today's traffic problems. Long-range area control involves detection of even small jet aircraft. Close-in approach and departure control involves high data-rate and extremely high target visibility within heavy fixed radar clutter. The SELENIA radar solves both requirements.

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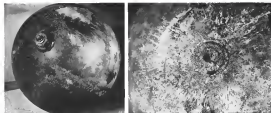
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Glenn Flight Atlas Booster Fragments Recovered

Hours before dawn the Atlas booster which powered the Titanides 7 V-2 was again into water and recovered late in February from a remote section of Deep Seabed, 2000 ft. South Atlantic. Four fragments were recovered. This little eagle shot 4 ft. and apparently penetrated the atmosphere after 60 miles. Effects of heating upon re-entry are evident in cleanup of metal.

about landing 70 hours in sight and 1935 hours in sight. It was the case in the day, during the night, and during the day. The effects of the heating upon the metal are evident in the cleanup of metal.

G-Lead Effect

Both in the course of operation of the ship and in the course of the day, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

From one point of view, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

By the end of the flight the engine was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Way may assume that the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Minimum maintenance can be done. The effects of the heating upon the metal are evident in the cleanup of metal.

the television display, which is on the ship.

By the general and primary result of the flight, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

First of all, it is evident that the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Second, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Space Suit Efficiency

Referring to the ship, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

The ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

The ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

The ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

All the various procedures for operation of the instrument component, system and hardware, system and hardware.

The ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Thus, the condition of the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Peace Appeal

When one can see the ship, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

From one point of view, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

And here is a picture of the ship, the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

Thus, the condition of the ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

The ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.

The ship was in the water. The effects of the heating upon the metal are evident in the cleanup of metal.



BACKBONE of instrumented avionics equipment will have built-in self-test systems to prevent costly checkout on the ground and in the air. Equipment (A to F) includes ATC transponder, marker beacon receiver, course and glide slope package, glide slope receiver, automatic direction finder receiver and tuning bank. New line makes debut this summer.

Bendix Builds Self-Testing Avionic Units

By Philip J. Klein

Enhance—Bendix Radio's new generation of navigation and instrument avionics equipment will feature built-in self-test provisions to enable maintenance men and pilots to check equipment operability quickly on the ground before flight and in the air.

The decision to adopt this integral self-testing feature throughout the new line of Bendix solid-state avionics equipment, dated to make an debut sometime this summer, is based on experience with the DR-12 Doppler radar and NV-13 navigation receiver, in which Bendix built and the technique.

The new solid-state equipment is under consideration by several major airlines for use on the Boeing 737 and is believed to be a major contender for the Air Force's Lockheed C-141 jet cargo transport, now under development.

Although the new line is somewhat smaller and lighter than predecessor equipment, the major emphasis has been its reduced size, weight and power consumption. From an avionics component, the size of avionics equipment already has been reduced to the point where individual units are too small for conventional radio rack installation. They can be used in an integrated avionics package configuration which will be used for the first time in the new Bendix line and competitive equipment. The navigation receiver, its associated marker beacon receiver and the glide slope receiver will be contained in a single short I-STR size case.

Studies made by Bendix, an outside consultant it hired, and others, indicate that serious failures are a major cause of avionics equipment failure, ac-

cording to George W. Clewley, assistant manager of avionics products.

Field data also reveals that approximately 10% of the units of equipment returned from aircraft as defective show no malfunction when they are returned to the shop for repair. This suggests that at least some of the units were needlessly removed, possibly with an unnecessary delay on an active flight.

Another explanation for these seemingly unnecessary removals is an automatic type of fault, possibly caused by poor contact on a relay or rotary switch, which was not repeat itself each time. With only margin information on the nature of the equipment malfunction, the service shop staff was unable to find any trouble and the equipment was re-installed in an operative unit, only to have the fault reappear at a later date.

Improvement Program

Bendix has directed its reliability improvement effort along three elements:

- **Environmental.** Vibration and semiconductor stresses are being used instead of tubes wherever possible. For example, the new RNA-20A navigation package, including beacon and glide slope, the new NKA-21A marker beacon receiver and the new DVA-75 automatic direction finder all are completely transistorized. The new TPR-61 air traffic control transponder is fully transistorized except for the final output tube of its transmitter. The DR-12A distance measuring equipment will be fully transistorized except for about half a dozen tubes, according to E. O. Hart, manager of avionics engineering.

- **Minimized mechanical motion.** In the belief that moving parts such as rotary

switches and relays are potential trouble sources, particularly of the electromechanical type, Bendix is using new all-silicones having and reversing contacts that eliminate the need for relays and rotary switches. The only moving parts, for example, in the new RNA-20A navigation receiver are the small servo motor and brushes used to operate the radio receiver's motor (RMI) in the cockpit.

• **Built-in self-checking.** The integrated reliability improvement from one of solid-state devices and elimination of self-moving parts focuses attention on the need to reduce, if not eliminate, necessary inspection intervals. A minimal which delays a flight has the same net effect on airline operations and passenger satisfaction whether or not the equipment has actually failed.

Bendix Radio first recognized the need for built-in self-checking provisions during the development of its DR-12 Doppler radar. To increase reliability for equipment in field environments, as well as for the transmitter output tube and two gas solenoid receiver tubes, Hart says.

But its overall compliance is nearly 10 times that of a VOR navigation receiver, in terms of the number of components used. On day four it might be expected to exhibit only a fraction of the mean time between failure of a VOR receiver, which would make it use questionable as a primary navigation aid for long over-water flights.

The fact that a Doppler radar is a self-contained navigation system is an operational advantage, but with the resultant disadvantage that its performance may need to be checked before takeoff, unless special provisions are incorpo-



CHECKOUT of ILS lockers and glide slope tests test pilot's ground calibration. When test switch is thrown to left, test signal should deflect indicator needles up and left to test dot, when clearance is solid needles should deflect down and right to test dot. Left plane shows indicator needle positions when equipment is operable; right shows deflection when lockers receive a misalignment.

ated in the equipment. This pointed up the need to build self-test provisions into the Doppler system, Clewley says. Bendix troubles pointed up other weaknesses, applicable to all types of avionics equipment. One is that any amount added to provide self-test must be at least one order of magnitude more reliable than the equipment to be tested. This means that the additional complexity must be built to a new maximum, and that it should use non-mechanical and solid state wherever possible, Bendix says.

Additionally, it is desirable that the cockpit indicators which the pilot will use also be employed in testing the equipment possibility, so that the panel display as well as the block board are checked in the process.

Self-Test Circuit

The self-test circuit which Bendix devised for its Doppler receiver the addition of such a couple of crystals and, approximately half a dozen transistors, according to Hart. It generates an internal Doppler signal at a 4.5 mhz intermediate frequency. This signal was the Doppler system at the point where the receiver located antenna connects into the transmitter receiver.

When a maintenance man is the pilot pushes the test button, the test signal is injected and should cause the pilot's panel indicator to show a ground speed of 600 kt. and a drift angle of 20 deg left.

The operation of the associated navigation computer can also be tested by the same means. A typical flight position can be set up and the Doppler test signal allowed to feed into the navigation bus, as 10 mhz. At the end of this period the computer's indicated air speed position can be compared with what it should be on the basis of a 30-mph high at 600 kt. with a 20 deg left drift.

The self-check provisions do not pre-

vent the test of the Doppler transmitter the antenna, or the moving detector coils in the antenna. However, Bendix has designed a small hand-held item which a maintenance man standing outside the aircraft uses at each of the four antenna radars to measure the level of energy being transmitted.

Federal Aviation Agency test articles and Texas World Airlines in depth as flight on evidence of Doppler system operability as established by the built-in accuracy and the use of the as tested.

The Bendix Doppler currently is exhibiting a failure rate comparable to that of a VOR receiver, despite its greatly increased complexity, according to a recent TWA figure.

An expensive in-depth servicing of the built-in test circuit has been pointed up in experience with the Doppler system. Where formerly a unit returned to the repair shop might have been "checked out" by having the service personnel to test out the nature of the malfunction and then its cause, the new built-in test feature may allow a pilot, or line maintenance personnel, to provide some service data on the malfunction.

Defines Trouble Area

For example, if the Doppler test produces a ground speed of 600 kt. instead of the expected 600 kt., but does give the correct drift angle, this information is most valuable to shop personnel in making trouble the malfunction.

The cost of adding the built-in test feature would represent a very small fraction of the cost of the equipment. When the additional cost is only 1.2%, the self-test provision really will be incorporated in all production units. For the nuclear business, however, because of its inherent complexity, the test cost is expected to add about 5.10% to the unit cost, and will therefore be of interest as an optional item. The self-test

circuit will be on a small printed circuit board which can be plugged into the bare board between chassis, if desired. In the VOR navigation receiver, the built-in circuit checks the operation of the receiver and antenna circuit, using a signal from any VOR station within range. In normal operation, the non-inverted detector, the aircraft's bearing to the station by comparing the phase of two signals, one a 30cps variable phase amplitude modulated signal and the other a 30cps reference phase frequency modulated in a 9,900 cps subcarrier. The test circuit injects the 30cps variable phase signal from the nearby VOR into both channels, giving a phase angle of zero deg., so that the pilot's RMI indicator should be centered, if it is operating properly.

The circuit not only checks to assure that the system is operating, but also that it is properly balanced if the needle is perfectly centered. The self-check does not test for the operation of the indicator circuit, but this is not considered to be a critical element. Since the self-test circuit obtains its signal from an outside VOR station, it also checks operation of the receiver and antenna.

ILS Test

The most critical aspects of the inspection approach position of the navigation equipment are the antenna. After counts which determine antenna position with respect to the center of the ILS lockers and glide slope, according to Hart. In view of current emphasis on lower maintenance for jet transports, Bendix believes it is particularly important that the pilot be able to check the performance and calibration of these circuits before he begins an instrument



When a giant thinks small

Lockheed becomes a prime source for memory devices—from tiny ferrite cores to entire memory systems

When you think of Lockheed, major aerospace achievements usually come to mind. But within the giant Lockheed Corporation is a complete unit whose success was attained by the company's ability, also, to think small. The result: in recent years the Lockheed Electronics Company has become a prime source of key computer and data processing components for industry and defense.

In an exceptional example of vertical integration, Lockheed Electronics is now producing a broad line of memory devices including single and multi-aperture cores, memory planes, stacks, and systems, printed circuitry, welded circuitry and computer modules. This under-one-roof operation has earned for Lockheed a reputation for quality, on-time delivery and versatility.

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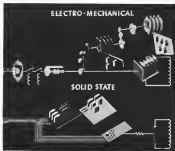
Lockheed's engineering follow-through draws work carefully with the nation's data processing equipment manufacturers to assure perfect integration into finished computer systems.

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SOLID-STATE circuit switching and timing will be used in new flight test, and in some competitive equipment, to eliminate need for relay cables and relays, which represent items to be source of unreliability. Improved reliability is major objective in new design.

approach This is one reason the ILS self-check circuit generates its own test signal rather than attempting to use the locator and glide slope beams themselves.

When in aircraft is on the center of the glide slope/locator beam, it obtains 90 and 150-ops signals of equal amplitude when self-check circuit is in the other is higher, depending upon which side of beam center the aircraft is flying. The test signal which Beards uses consists of a 90- or 150-ops tone, generated by a small transistor oscillator.

When a test switch is thrown to the left, the transistor oscillator generates a 150-ops tone of controlled amplitude which is injected into the balanced filter section of the glide slope and locator receiver. If they are functioning properly, the glide slope needle in the cockpit will move up to the first dot on the instrument, while the locator needle moves to the first dot on the left.

When the test switch is thrown to the right, the oscillator injects a 90-ops signal which should cause the glide slope needle to move down and the locator needle to move to the right to the first dot on the instrument bar.

By observing the action of the two needles when the switch is in both positions, a maintenance man or pilot can thus do a check of condition about the condition of his ILS receiver.

If both needles fail to move, one or both receivers are inoperative.
If both needles are not equal on either side of the neutral position the corresponding receiver is not properly balanced and will not guide the aircraft properly down the center of the beam.
If both deflections are equal but insufficient to reach the first dot, the receiver has lost sensitivity. However, if both glide slope and locator needles are off from the prescribed deflection by the same amount, it is likely that the self-check circuit is out of calibration.

Additionally, the warning flag operation can be checked since it should drop down into view for both test switch positions. The flag is designed to drop into warning position whenever the receiver fails to obtain both a 90- and 150-ops signal, which is the case for both tests since only one tone is injected at a time.

The added cost of providing this ILS self-check circuit is estimated at about 1% of the total navigation receiver package, but current thinking at Beards is that it will be achieved on an optional basis as a plug-in circuit.

The self-check circuit for the receiver Beards receiver consists of a 75-mc crystal oscillator, which is heterodyned with a normal oscillator, to produce a modulated signal whose frequency ranges from below 400 cps to above 5,000 cps approximately, once every 10 sec. When the test button is pushed, and the signal is injected into the antenna antenna receiver, it should cause the blue middle needle to be pulled, followed in sequence by the amber outer marker and the white airway center needle. The circuit checks

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Pratt & Whitney Aircraft to deliver first JT8D turbofans for Boeing 727 flight tests

Sometime soon, three off-mounted Pratt & Whitney Aircraft JT8D turbofan engines will power the Boeing 727 jetliner on its initial flight—little more than a year after the engine ran for the first time.

Swift progress is possible because the JT8D's basic design has been proved by more than 20,000,000 JT3 and JT4 flight hours. Capitalizing on this experience, Pratt & Whitney Aircraft has developed a lightweight, high-efficiency powerplant with 14,000 pounds thrust. The JT8D achieves this advanced per-

formance through a design concept already familiar to operating personnel at 30 world airlines.

With its trio of turbofans, the 727 can operate at full load from 5,000-foot runways. This 550-to-600 mph jetliner is designed for profitable operation over low-density routes with 1,500- to 1,700-mile stage lengths. To date, United Air Lines, Eastern Air Lines, American Airlines, Lufthansa, and Trans World Airlines have ordered a total of 127 planes. By 1963, the 727 will bring the benefits of jet travel to new cities throughout the world.

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the operation of the system's magnitude except for its antenna and feed.

The internal test circuit and to check the ATC response against a controlled mechanical motion, using a crystal and three transducers which produce a pair of pulses with the adjustable width for which the transmitter has been set. When this pulse pair interrogation, simulating that normally obtained from the ground is received in the RF feed to the transducer, it should cause its transmitter to reply. This is then will cause a cockpit lamp or electronic channel transducer, to indicate that the beacon is being interrogated in the same way that a regular ground interrogation is subjected to the pilot.

By controlling the amplitude of the test signal injected, it is possible to check the sensitivity of the transducer's receiver. The test also checks the operation of the decoder, but does not check the output of the transmitter—either its power frequency or reply code. But and, however, the delay line and several other parts of the encoding circuitry are partially checked, since they have been used to form the pulse pair injected as a test signal.

Bosch plans to incorporate self check in all of its ATC transmitters, involving an additional cost of about 1%, because the circuit cannot conveniently be designed as an optional plug-in unit.

The self-check circuit for the distance measuring equipment uses the output from the reference transmitter which is achieved by a preselected wave signal heterodyned with a transmitter oscillator to produce a signal at ground station reply frequency, and then returned to the reference receiver, which interprets it as a reply from a ground station. The panel indicator should then display a distance corresponding to this



Analog Computer

New mechanical analog computer, the FVCE TR-60, a wide range in 60 on a desk or mobile cart, but provides up to 40 operational amplifiers, 40 individual potentiometers and 20 other computing components, such as multipliers and function generators. All gains present can be accounted on a digital electronic by means of push-button control. Manufacturer: Electronic Associates, Long Beach, N. J.

delay. This test checks the operation of the transmitter, receiver, and the cockpit indicator and ranging circuit accuracy.

Bosch estimates that the extra cost of such circuits will amount to less than 2%, and says the company has not yet decided whether it will be offered as an optional item or included in all DME units.

Despite Bosch-Rohde's enthusiasm for its new self-check design philosophy, the company does not propose that it will completely eliminate the need for line maintenance test equipment. In fact, the company is designing a complete line of both ramp and step test

equipment for its entire new generation of avionics equipment, the last issue that the company has done so.

One indication of possible customer interest in the new built-in test provisions comes in the current investigation held by USAF's Acquisition Systems Division to select a contractor to supply the navigation package and ADF for the new Lockheed C-141.

When Bosch submitted its rugged question it included extra costs for the basic equipment, without self-check provisions. Already Bosch was asked by Acquisition Systems Division to select a new question based on the release of this new feature.

HOLLEY VALVE "ROLLS" THE VZ-10 "HUMMINGBIRD"



ROLL CONTROL DEVICE HAS WIDE APPLICATION

The VZ-10 "Hummingbird", Lockheed's versatile, high-speed research VTOL aircraft now under construction for the U.S. Army, uses a Holley-developed "Roll Control" valve to swing wing tip, to provide attitude control during vertical take-off and landings and in hovering flight maneuvers.

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Designers can realize maximum benefit from the tube's small size by adopting mounting and cooling arrangements to meet specific environmental demands. Cooling may be air, heat sink, or liquid.

BROAD APPLICATION POSSIBILITIES

In addition to its small size and physical ruggedness, the STX-186 boasts per-

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Across the entire band of 7 to 11 Gc, this new TWT delivers a minimum 10 watts CW at up to 60 db gain. The dynamic range of broadband signal applications extends 25 db below saturation. These characteristics make the STX-186 especially suitable for radar, drone, and aircraft applications in radar augmentation, DCM, or communications systems.

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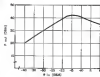
Sperry is now producing the STX-186 in quantity, and limited numbers are available within 60 days of receipt of order.

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Typical drive curve STX-186 at 9 Gc



CERAMIC SUBSTRATE is loaded into hopper of machine left which prints circuit patterns at Autonetics Research Center. After screen printing, substrate comes on belt through drying oven and are removed at rate of oven, in shown in background of photo. Right, in-oven exposure checks makes pattern printing on mechanical mountings of pattern line in development at Autonetics Division of North American Aviation. Company currently is developing commercial screened microwave substrates.



Screened Circuit Processes Mechanized

By Barry Miller

Anchorage, Calif.—Controlled, mechanized processes for microelectronic fabrication have been developed by the company's laboratory which can be used in its fabrications, aerospace, and commercial electronic systems are being developed here at the research center of Autonetics Division of North American Aviation.

Like many other systems and equipment manufacturers, Autonetics is seeking to reduce the prime cost of microelectronics to reliable and economical production. It is looking at several microelectronic approaches which lead themselves to mechanized fabrication in the belief that controlled processes will lead to high yield, economical manufacture of microelectronic circuits. As one example, of the approaches being investigated and those already automated, made and equipped the microelectronics as well as integrated microelectronic circuits—may go into the company's next military projects depending on timing and reliability.

Reliability Emphasis

With the emphasis Autonetics places on reliability, particularly in its Military and CRM guidance and control systems programs (AW Oct. 10, 1970, p. 69; Dec. 12, 1969, p. 99), it is not surprising that the company is step stress testing thousands of steel mounted microelectronic coming off its mechanized development process line here as an

effort to determine circuit reliability.

The partially mechanized process line now is apparently turned out microelectronic made by the company's Micro Circuit printing process known as serigraphy, or silk screening, in which an ink is passed through a stippled wire (or silk) screen into metal on fine circuit patterns. The patterns are repeatedly printed through a high resolution, 10 to 100 mesh inch in a screen printing machine which in the initial step in screen processing. The patterns are printed on alumina, or ceramic, substrates, presently 14 in. by 2 in., fed to the machine by a pre-loaded hopper or magazine.

After the patterns are printed, the substrates are dried by a nitrogen belt

through a few temperature steps to 600°F over in dry out the screened pattern. Escaping from the oven, the masks are removed to load placed on an adjoining belt which passes them through a high-temperature furnace (to 1,300°F) that melts a film in the screen and conductor patterns in place on the substrate.

Autonetics plans to control stacking fixtures at the end of both the oven and furnace so circuits can be fabricated without human participation.

The line can turn out screened microcircuits at a yield rate more than 70 per cent to 120 per cent. The lower figure appears particularly for opto-electronic. The circuit process, in



SCREENING process steps in preparation of screened microcircuits at Autonetics are shown. Substrates shown are 1 1/2 by 2 in. Company has fabricated on the days composed of 144 components, on 12 sq. in. ceramic substrate.

Turning theory into hardware

Technological breakthroughs are almost an everyday occurrence in electronics. Everywhere we see many new scientific discoveries being turned to the service of man.

Hughes is one of those companies whose obligation is not only to form these theories, but also to visualize how they might be applied. And then to make that application—both in man's defense and in the betterment of his life.

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"No-rock" radar

Aware of the limitations of conventional radar which must "look" to position its targets, Hughes generated a technology where the beams are propelled electronically based on land or aboard ships. This enables over 3 dimensional information coverage, meaning that attitude is on hundreds of targets. Even more advanced Hughes solutions, which search hundreds of miles off shore, are now on operational duty.



Satellite "switchboard"

Soon NASA is scheduled to launch the first communications satellite capable of being directly uplinked and positioned in a 50,000-mile-high synchronous orbit. Just three or four Syncom satellites could relay the telephone, TV, telegraph and teletype messages of 130 nations. Hughes—developed and built for NASA that Syncom system could add a new dimension to space communications with a one-step



Polaris missile brain

Through the application of its advanced manufacturing technology, Hughes is now a prime contractor in inertial guidance systems (illustrated above) for the U.S. Navy's Polaris missile. It is one of the world's most advanced, most reliable forces for freedom.



Modern Falconry

In the late 1940s, airborne electronics went on its affinity. Yet, in a few years, U.S. Air Force jets were equipped with Hughes advanced weapons control systems aimed to fire F-86 fighters. Together (and vastly improved) they have become our most potent air defense weapon. Hughes—the leading builder—has gathered thousands of control systems and will now 20,000 trained and eager skilled persons.

at Hughes

A few are shown to illustrate: Completely new technologies which are creating new devices... Major improvements in existing technologies... Advanced manufacturing technologies which produce more reliable hardware for duty in this world—and out of it.

More than 5,000 Hughes engineers help create the theories. More than 20,000 other skilled Hughes people help translate their work into practical hardware. Together they are helping create a new world with electronics.



Boxed air defense systems go anywhere

As lifted by helicopter to inaccessible areas, Hughes new "packager" air defense radar systems can be ready for operation in minutes. The "helicals" contain a highly miniaturized "operator's console" and communications networks are sufficient to control all U.S. Army and Marine Nike and Hawk missile batteries.



lon engines for deep-space probes

Hughes research into the theory of electrical propulsion has led to development of ion engines which are called the 'viators'—source of power for deep space trips. Built for NASA, Hughes calcium-powered ion engines have been 'test flown' in space simulating vacuum chambers and are scheduled for initial test on board within the next



Missile checker

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Automatic Tester has a built-in intelligence of 1 million bits of information. This capability is now in the U.S. Air Force's NVII program to check and evaluate ICs in flight—in less time, with greater accuracy, at less cost.

Creating a new world with electricity

HUGHES

Microelectronics

Heat, vibration, over-weight stresses are the enemies of common electronic circuits. One example of Hughes' use of Microfilm for film technology puts it in a considerably different class. It is thin, light, rugged, cooler and more reliable, it can withstand the most rugged usage in aerospace. *— Electronics World*



Freeway at 30,000 feet

every ten minutes a scheduled aircraft speeds along this lofty highway. It may be Britannia or Boeing 707, Viscount or Vanguerd, Argosy, Friendship or Comet—but whatever the aircraft, its aids to safe flight and punctual arrival are likely to include SMITHS Instruments. Right round the clock, SMITHS are helping to guide traffic along the world's air routes; helping thousands of aircraft to fly fixed courses at fixed altitudes, meticulously maintained by sensitive yet sturdy equipment; helping them to cover at least two million miles a day.

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shading 5 mm, passing through the moon and 12 mm through the horizon, takes less than 20 mm for an individual circuit. Minimum line widths of the patterns are 3 mils (plus or minus 2 mils), created by an accuracy of 2 mils, according to Stan J. Griffin, who heads metallization process development here. Griffin previously was a special engineering manager at Avcon Corp., which had done earlier work on aircraft instruments.

Conductors and resistors of different ohmic values are screened on the substrate in separate operations. A changeover from one to the other, or a replacement of the steel screen pattern, takes only a few minutes.

After being screened are checked for value, and if need be adjusted upwards by photo etching. In an alternate process which removes part of the substrate material. A photo etching technique also is under examination.

Tolerances of surface resistivity in the developmental line, have a range value of 10% where upper is defined on the screen dimension from the intended one on point of a full distribution curve, of the fabricated resistor values. The upper value, minus 50% of resistor value error.

Printed Film Use

Two different types of printed films are used in resistors in the shell screened process. They are a carbon medical grade, or decadic paper from 100 to 100,000 ohms, the other is a glass or ceramic film composed of metal powder with a ceramic base that appears superior for high temperatures, these resistors reside over a more restricted ohmic range.

A shell screened capacitor capabilities in under development, but has not yet yielded capacities larger than about 100 picofarads. To get the maximum benefit of circuit components and conductors which can be refined by the micro level that screening process growth followed by the technique will be designed to minimize use of conductors, large valued capacitors and will employ direct and diode coupling between circuit parts.

Screening this wafer the process line is expected to be moved from the laboratory, into an Aerospace factory.

Once the conductor and their resistor patterns are sequentially screened and fired on the substrate, the connection on the substrate, and additional components, such as trimmers, diodes, tantalum capacitors, are added in thermal bonded to the substrate. In a final step, substrates are placed in a special gaseous and encapsulated. Shipments via air carrier transmitter and lead connections, to be followed later by humidity and temperature shock tests, are

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Hurdles—completely self-efficient missile launching facilities, based deep underground, are part of the "big stick" protecting our nation.

One of many shock vibration and noise control problems solved by Barry Controls was that of protecting sensitive launch equipment from devastating effects of a three-megaton blast.

Non-sagittized commercial equipment, with unknown fragility levels, had to be effectively isolated from shock and vibration in order to meet stringent hurdle specifications. Special Barry isolators, produced after careful analysis, design and testing, provided the protection.

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A rugged complex of deep pits, sand flats, thick woods and rocky bluffs, the two Caterpillar proving grounds provide a wide range of terrain and climate conditions... 10,000 acres of mud, dust, snow and ice... desert and sub-zero temperatures.

Located near Phoenix, Arizona, and Peoria, Illinois, the sites are in constant use by Caterpillar's 1300-man Research Department. Once a basic design has been approved and a prototype developed, equipment is subjected to a series of rigorous tests. Through modern instrumentation, performance data is quickly obtained and evaluated.

Mobile instrument laboratories, like this dynamic measurement van, allow Caterpillar researchers to probe deep into the heart and liver of machines.



In actual field operation the van's crew is putting Caterpillar's mobile, rubber-tired eight-ton QOER through a strenuous test, simultaneously measuring 16 different operational characteristics.

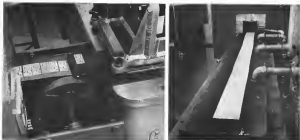
In addition to the comprehensive proving grounds facilities, Caterpillar maintains an extensive fuel testing and research organization wherever Caterpillar equipment is used—first looking for faults to correct, then for improvements. Research specialists work with other Caterpillar engineers and manufacturing people in every stage of equipment development—from basic concept to final manufacturing. It's all part of Caterpillar's continuing program for the development of new concepts in military vehicles, their components, and power packages.

For more information, write Defense Products Department, Caterpillar Tractor Co., Peoria, Illinois.

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SCRAPPED MICROCIRCUITS are shown after circuit patterns have been removed, left, being carried on a belt through the drying oven. Right, circuit substrate mounted on a moving conveyor belt from high temperature drying oven. Subsequently, resistance values can be adjusted, additional components—matching diodes and transistors—can be soldered on (shown soldered to the substrate), and the entire substrate then encapsulated. Automation may one day permit like this in thousands of microelectronic parts in large quantities.

being conducted with accepted circuits. Distribution of scattered failures is plotted against time.

In daily runs of accepted circuit samples of 100 samples, approximately found through step-by-step testing for periods less than 6 hr that carbon screened resistors are less susceptible to change by heat than comparable Manganese resistors. Relatively, comparable to that achieved by Manganese resistors is expected for longer duration. Storage life over long periods, within the tolerance of present testing, should be about one to two months.

Hardware Tests

To test selected circuits in an actual operating period of hardware, the Electrical Non-pilot Division of Autometrics redesigned and manufactured an Army contract, to give complete, using accepted circuits. The original equipment, including single test gear, power supply fan and thermostat, weighed about 115 lb. The Army asked for short time delivery of a more portable unit, with capability of providing an accuracy resolution to 1 mil of sec within a 10-sec period.

By cutting size and weight in a number of areas, Autometrics developed a discriminator unit weighing 35 lb. (The new unit hardware accounted for another 6 lb.), called MARLE (Marine Autometrics Resistance Limiting Equipment).

The electronic portion of the discriminator was reduced from 14 lb. to 0.5 lb. by the use of the ceramic based microcircuits with discrete active components and expansion added.

Other appreciable weight reductions were made possible by the use of a smaller thermostat, a more compact gas electronic model gear, a more compact of circuit redesign.

For this application, two wirewound resistors are sandwiched about a metal mount which provides for conduction cooling, and the entire unit, or chip is then mounted with one long edge mounted to a conventional printed circuit board, its leads inserted into the board and soldered from the rear. The

extremes portion of the resistor is clad in insulator slip tape, ring cover its, wire and solder amplifiers. A 24 v. power supply, are connected on twelve such chips mounted on the circuit board. In this case, chips are not encapsulated.

The MARLE unit is being evaluated under varying temperature conditions by the Army in tests at Ft. Sill, Ft. Belvoir and in Alaska. The unit was cold soaked at -55° for 8 hr, without chip failure. It worked well down to



RESISTANCE VALUES can be adjusted by discrete techniques shown in one photo.



MB's T-388 Automatic Equalizer cuts equalization time to 5 seconds...

Production random vibration is now practical with MB's completely automatic spectrum equalizer. Set up time is shortened and equalization achieved within 5 seconds. Savings in test time and labor for machine and aircraft manufacturers can easily reach many thousands of dollars per missile tested.

Operation of the T-388 automatic equalizer is extremely simple and can be readily handled by non-technical personnel. A flat or shaped spectrum is easily programmed on the spectrum control panel by setting the slide wiper. A template of the spectrum can be used for the



Integrated at just \$10,000, MB's unit is used to test set up of the T-388 Automatic Equalizer.



rotting as shown above. The equipment costs the most.

The T-388 also provides higher test accuracy and versatility. Equalization to $\pm 1\%$ db is obtained and represented extremely closely; compensation shifts in resonant frequencies and changes in amplitudes. Narrowest frequency range is 35 to 2000 cps in 25 cps bandwidth; any 2000 cps bandwidth can be obtained between 10 and 18,000 cps by simple front panel selection.

Other angle features of the T-388 Automatic Equalizer include:

- Spectrum analyzer has 5 types of readout: 1) graphical, direct

reading in $\mu\text{V}/\text{cps}$; 2) visual display on scope for continuous monitoring; 3) permanent record of test using X-Y plotter.

- Highly accurate equalization through the use of 80 distinct channels of narrow bandwidth (25 cps) covering a 2000 cps band.

A test laboratory equipped with the T-388 test unit not only saves many hours of valuable test time, but will also be prepared for present and future test requirements.

For detailed information on the T-388 Automatic Equalizer write to: MB Electronics, P.O. Whalley Ave., New Haven 12, Conn.

Over 50 Mail-Filter Equalization Systems purchased by leading test laboratories

The inherent contribution which the Mail-Filter Equalizer system makes to the field of vibration testing has been recognized by leading test laboratories.

To date over 50 units have been purchased a remarkable record for equipment of this type.

Mail-Filter Equalizers will give you the unique advantages and savings of the Mail-Filter Equalizer System in your test program.

-40F. but at -65F. Distortion level in the gfs. band is low. The power amplifier section will be reduced to microelectronic stages in the near future.

The second microelectronic approach is referred to by Dr. Robert Adkins, vice president of Autometrics who heads the company's research and development department here as the first of several sequential steps he foresees in the company's adoption of microelectronics. This approach, he says, potentially is less expensive than other ways to approach and close in time to practical use. As backups for the first step research emphasis also is investigating a two mode SSB system and equivalent circuits as a secondary backup.

Integrated Electronics

The second step to continue as in integrated electronics and beyond, that some of the more sophisticated concepts of solid-state electronics.

Adkins points out that the mission of the research center is to make available advanced techniques in other Autometrics divisions, to provide knowledge in new systems, to integrate various products activities and work in new equipment.

He contends there are differences within the company about where it is to go in microelectronics, but explains that none of the divisions is completely in the R&D laboratories to accept new research. Reliability and cost, with no electronic failure rate of less than one failure in 100 million per hour are dominant considerations in the amount of switch, or switch in an given approach.

Which units are actually incorporated into Autometrics systems more depend on timing and customer choice, he points out. What he regards as the second step, integrated circuits, has developed surprisingly fast, he notes and a time difference between this and the first step may be diminishing.

Other Firms

Autometrics currently is working with a large number of integrated circuit manufacturers, including Texas Instruments, Fairchild, Pacific Semiconductor, Motorola, Clevite and Sanyo, among others, and life testing integrated circuits. At the same time, it is evaluating an external semiconductor capability to evaluate these efforts and to explore future concepts.

The microelectronic approach as approaches, which Autometrics adopts are expected to have considerable influence on the future directions of microelectronics throughout the industry because of the company's large volume of military systems business, the large number of digital circuits in its equipment.



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Acknowledged leader for over 14 years in the design, development and large scale production of Doppler navigators, flexible, fast-moving Ryan is also making significant contributions in other areas of the space age.



RYAN ELECTRONICS Ryan Electronics was selected by Hughes Aircraft Company, Inc. to design, develop and produce the Ryan XV Doppler Navigator. Ryan XV also makes possible the all-weather, precision navigation of slow-flying aircraft such as helicopters, SSTOL, and all types of land wing aircraft now flying on projected.



RYAN ELECTRONICS Ryan Electronics was selected by Hughes Aircraft Company, Inc. to design, develop and produce the Ryan XV Doppler Navigator. Ryan XV also makes possible the all-weather, precision navigation of slow-flying aircraft such as helicopters, SSTOL, and all types of land wing aircraft now flying on projected.

Ryan, for example, is now building the newest concepts in vertical take-off aircraft. And today, as in years past, Ryan is the major supplier of advanced jet target drives for all the Armed Services. Among other Ryan services are Pitt Wing applications, electronic systems for laser landing, and systems for space vehicles.

Ryan Electronics includes the most modern and best equipped facilities for electronics development, manufacturing and testing. And in Ryan Electronics and Ryan Aerospace, technical and management capabilities are designed to assure compliance with the most stringent standards.

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA

**RYAN
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RYAN ELECTRONICS Ryan Electronics was selected by Hughes Aircraft Company, Inc. to design, develop and produce the Ryan XV Doppler Navigator. Ryan XV also makes possible the all-weather, precision navigation of slow-flying aircraft such as helicopters, SSTOL, and all types of land wing aircraft now flying on projected.

The Effect of Lead in Alloy Steels, PART II

This discussion touches upon working properties of leaded alloy steels and when their use should be considered. Part I, which appeared earlier, dealt with basic definition, the reasons for excellent machinability, and the purpose of closely controlling lead additive.

WHAT ARE THE MECHANICAL AND WORKING PROPERTIES OF LEADED STEELS?

The mechanical properties of an alloy steel are determined principally by its basic chemical composition. The addition of lead in the specified quantity and with uniform distribution does not change this composition, and hence does not alter the mechanical properties to any appreciable degree. This is because lead remains its elemental form and does not alloy with the steel.

It follows that leaded alloy steel will roll, forge, bend, form, draw, etc., in the same manner as does the base alloy steel. It can also be torch-cut, welded, brazed, or heat-treated, again as determined by the working properties of the base steel.

Care must be exercised, however, during any operation which involves heating. The heating operation should be in a well-ventilated area so as to avoid any chance of the lead vapor concentrating in the atmosphere to create a health hazard.

WHEN SHOULD LEADED ALLOY STEEL BE USED?

Leaded alloy steels may be used in all types of machining operations to attain increased production and longer tool life, in comparison with non-leaded steels. The advantage of leaded steel becomes more and more positive as the amount of

machining required for the individual piece increases. Definitely, it takes a job that requires at least 25 per cent chip removal before leaded alloy steels become economical. This type of job is usually characterized by machining operations which require high rates of metal removal.

Another point to consider before making the decision to use leaded alloy steels is whether the speed of the machine tool can be increased. This is no problem for a relatively new machine, but older machines have a definite limit which may be below the speed needed to take full advantage of the superior machining properties of leaded alloy steels.

Forged parts, too, often require extensive machining after the forging operation, and might, therefore, be manufactured more economically from leaded alloy steel. As a result of their vast experience in this field, Bethlehem engineers usually can quickly determine whether the use of a leaded alloy steel would be feasible. Their impartial advice is available at no obligation. Call them if they can help you in any way.

In addition to manufacturing all AISI standard alloy steels, Bethlehem produces special-analysis steels and a full range of hot-rolled carbon grades.

This series of alloy steel advertisements is now available in a compact booklet, "Quick Facts About Alloy Steels." If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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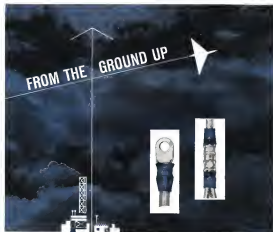
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- Stop lock attachment at sleeve to terminal barrel, to assure proper positioning of insulation during and after its assembly to the wire
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Thermal and Air Technologies

which lead themselves to mechanism, and the capsule is put on its table. The company currently is seeking new semiconductor buyers to take up engineering work created at its Mountain guidance. Filter units are ruggedized and other military without business moved into production stage.

System Bids

It has bid recently for parts of the Aquila guidance system. These 1 aerial guidance and has proposed new version of Mountain guidance, some of which was suggested by the microelectronics approach being investigated in these laboratories.

Among other microelectronic approaches that are being investigated by personnel of the Automatic search center are the following:

- Magnetic film memories
- Plasma films
- Sub task switching of tandem film

The company is participating in an investigation or assembly scheme in which subunits would be fed back into a multi-level, continuous.

Automatic also has recently considered the related module approach to high density component packaging (AW Oct 10, 1980, p. 71) and has advanced it to point where this technology is available if it is needed, the company says.

In its on-line film system, its code film are applied on aluminum or glass substrates by a coating technique, a combination of laser and substrate heating, in which the substrate is heated to 600°C to 800°C.

A coded film (electronic mask) is deposited a photo-stitch material applied area exposed to ultraviolet light through a photo mask of the conductor pattern, according to Frank Rex a project staff engineer. The effect is then etched away leaving the conductor pattern.

Photo Masking Reported

The photo masking procedure is reported for the master pattern and the film is etched. The conductors are etched and additional components are then attached by resistance soldering.

Resistivity values range from 450 ohms to 85,000 ohms (plate or space 575). Resistance is as good as the mask.

A major problem with this process, which is not yet commercialized, has been in achieving an amir, according to Automatic.

Nickel rather than copper is used in conductors at it adheres well, is more chemically stable than copper, and appears to be a better method, according to Automatic.

FILTER CENTER

• **Al/Ni May Tripled Avionics-Six** coil magnetoresonance are currently considering the installation of three sets of this magnetoresonance and magnetron equipment on their new Boeing 777's instead of the long used duplicate magnetron. It is carrying a space on board, which can be switched into use in event of failure: the antenna will eliminate need to stock spare in its station. While the idea is not a new one, it has only recently become feasible with the significant increase in size and weight of antenna equipment and the increased economic penalty of jet transports which are grounded for lack of spare antenna equipment.

• **Low-Cost Synthetic Quartz** Development-Southwest quartz which is actually the same synthetic quality as natural Brazilian quartz can be stored quickly and inexpensively in a new process devised by Bell Telephone Laboratories. It using a silicon dopant with small amount of lithium. BTL reportedly claims that can grow high-quality crystals at rate of at least 40 to 50 inch per day, more than three times the previous maximum rate.

• **Promising Phase Shifter Developed**-New mechanical continuous phase shifter and frequency translator, for use

in intermodulation, performs frequency translation at more than 100 GHz, several times higher than previously possible with the piezoelectric phase shifter. Developed in the Naval Research Laboratory's Radio Division. The existing element consists of a resonant dipole supported within a circular waveguide, one-quarter wavelength in length of a resonant or shorting plate. Another feature is that continuous frequency components in the output are over 30 dB below upper carrier level over most of the band from 8,100 to 9,600 MHz.

• **New Thermoelectric Cooling Effect**-New type of thermoelectric cooling, discovered by Dr. M. A. Matzke of the University of Connecticut, is likely to replace the Peltier effect for many applications. Matzke reported at the recent meeting of the American Physical Society in Washington. The effect is due entirely to the backward migration of one type of carrier in a forward-biased PN junction.

• **Announce Review Transistor List**-Aero-nautical Radio Inc. plans to list its preferred list of transistors for use in aviation avionics equipment and will hold an industry conference on the subject in Washington, D.C., beginning June



Trident Autopilot Simulator Developed

Autopilot system, developed by de Havilland Aircraft for the Trident jet transport, has been installed to verify simulator and control log to be used in testing automatic landing study. Big also will be used to investigate engine control movements and manner control problems for Trident and de Havilland's D68-25 executive jet, now under construction. Device presents visual picture on closed circuit television system, shows pilot a log of pitch, roll and yaw, presented on display lines. Pilot corrects this on problems from being concerned in the system.



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► **New Role for Inertial Guidance**—New Air Force mapping and charting system, the AN-119Q 28, is to be used as an important asset for precision photo mapping and cartographic production. The system, which employs an inertial guidance system to enable aircraft to fly precisely straight and parallel tracks, is now also used as a Doppler radar and into aircraft in support of the tactical situation. It is used to achieve required accuracy. Maj. Walter M. Roberts reported at recent conference meeting of the Institute of Navigation in Washington, D.C. The AN-119Q 28 will be used by the Air Photographic and Charting Service of MACV.

► **Texas Alloys**—Schlumberger-Franco, Patrick & Miller, Los Angeles, developer and builder of advanced display systems and a subsidiary of Long-Term Vought, Inc., for the past year, has now been completely absorbed by the parent company. New name will be Texas Electronics Display Systems plant, Rio C. Bayless, of LTV, has been appointed general manager. The plant is making displays for naval tactical data systems and recently completed installation of a display for North American Air Defense Command.

► **Ready to Assemble New Autogates**—New Series 60 autogates for jet engine aircraft, expected to reach first test 80 ft and will be under \$1,500,000, will be assembled soon by Edgemoor Power division of Bendix. Autogate will employ leading blade design, providing addition of extra surface and resistance.

► **Demand for Engines Increases**—In diesel engine contracting effort is up significantly from a year ago, based on the amount of advertising space purchased for recording in newspapers and technical publications according to figures released by Deutch & Shon, Inc., New York City. Figures for March show approximately 41% more advertising space than for same month in 1961.

► **Automotive Industry on the Move**—Pittsburgh-Schenectady, Mountain View, Calif., in a reversal of the usual pattern, will open its Ford Co. production facility in South Pasadena, Mr. Feltz, stated to be in pilot production this fall, will employ 250 by mid of the year. Other recent industry developments.

► **General Problem**—Equipment Corp. and Mitsubishi Electric Manufacturing Co. of Japan, have formed a new Japanese company Mitsubishi Precision Inc., which is a 12 division from the parent Japanese firm and four from GFE. The

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for equipment qualification tests, sonic fatigue testing of structural components, free-field simulation of jet or rocket engine noise.

The Acoustics Division of Tenney Engineering, Inc. is the world's foremost specialist in high intensity noise systems featuring highest intensity random noise (150,000 acoustic watts), widest frequency range for simultaneous random noise (10 to 40,000 cps), discrete frequency generation (50 to 10,000 cps), spectrum shaping capability, highest peak to RMS ratios.

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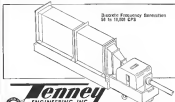


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For maximum flexibility, all Tenney systems are portable and expandable. Large volume chambers may be combined with the highest possible sound pressure levels.

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The inner conductor is closely supported by a polyethylene helix within a corrosion-proof, seamless aluminum outer conductor. For applications involving

high temperatures (100° C-250° F), PD Helical Membrane cable with Teflon® insulated for polyethylene is ideal.

PD Helical Membrane cable of 50, 75 and 100 ohm impedance is fabricated in 1000-foot continuous lengths and in standard sizes of 1/8", 1/4" and 1" diameters; other sizes from 1/16" to 3/16" on order. Complete cable systems, including attachments and connectors, are available. Your Phelps Dodge representative will be glad to give you additional information. PD Helical Membrane cable is made by Phelps Dodge Copper Products Corporation at Yonkers, N. Y.

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new firm will produce thermally stable platforms designed by General Precision's Kevlar Division and a light monitor designed by Tek Division, for use with P1661.

General Electric will build elements of its Atlas Mission guidance system at a new leased 150,000 sq. ft. facility in Oklahoma City, Okla., the company's first in that state.

Varian Associates and Compagnie Generale Thomson-Houston of Paris will form a jointly owned company to develop, manufacture and sell microwave tubes to the European market. Plans call for an initial staff of 175, expected to double within several years. Miquette interest in the new firm will be held by the French company.

Geo Space Electronics Co., Houston, Tex., is a new firm formed for research, development and manufacturing of electro-mechanical and low frequency instrumentation. President is Louis B. McMahon. Address 5511 S. Main Ave.

Signed on the Detroit Lase-Magor contract award recently announced by various manufacturers include:

• Helvex Electronics Systems, Buffalo, N. Y.—\$475,000 Air Force contract for production components for the AN-111N-51 precision Doppler radar navigation system.

• Radio Corp. of America, Electron Tube Division—\$1.5 million award for four electronic modules from North American's Avionics International Division for use in Strep-80A nuclear reactor for space vehicle use.

• Vero Electronics, Silver Spring, Md., will provide Mexican tracking network with expanded capability to receive wide-band PCM (pulse code modulation) telemetry data under a contract awarded by National Aeronautics and Space Administration.

• Radio Engineering Laboratories, Inc.—\$400,000 contract from Air Force to build transportable communications communications tropo scatter path test measurement facility.

• Collins Radio Co.—\$512,800 Air Force award for construction of an transportable high frequency radio communications terminals similar to 23 with several power levels.

• Texas Systems Division, Cambridge Mass.—Contract in excess of \$1 million for development of data collection and analysis system for per-battle check-out of satellites from NASA's Goddard Space Flight Center.

• Spacing (KCM) Detection—Air Force now make attempt to use if special direct launched with ballistic missile test shots from Cape Canaveral and in devices to confirm, unclassified KCM detection status such as Madsen and Bueche and missile launched with ballistic missile interception using passive homing

NEW AVIONIC PRODUCTS

• Welded circuit components, a line of precision vacuum and custom transformers with leads made of different materials suitable for welding or soldering. Transformers are available within 30 to 60 days in 1 watt power range depending on frequency and other requirements. Resistance range is value from 100 ohms to 175,000 ohms with dissipation up to 1 watt. Manufacturer: Schenectady, Inc., 280 N. Avonlea Blvd., El Segundo, Calif.



• Silicon micro device, MC055, with leakage currents in the pico ampere range, is suited for ultra-low signal applications will operate from -60C to 175C and is used to meet or exceed MIL-15100B spec. Manufacturer: Microelectronics Corp., 11570 Pine Court, Culver City, Calif.



• Digital counter which provides data shift to each of 180 positions controlled by external square wave. Squares vary from 50 to 600 pulses/sec. Contact resistance is 0.4 ohm (contacted) leakage is 100 megohms. Power consumption is 100 mW and weight of the hermetically sealed unit is 24 or 30cc w/ 51,200 Manufacturer: Lead Instruments, Inc., 2194 Moss Dr., Mountain View, Calif.

• Digital module for spacecraft data processing system operates at frequencies up to 2 mc; from 5 to 15 quanta of power. Typical data acquisition rate built from these low-power modules will sample 50 experiments, store 100 million bits, process 500,000 bits in at total power consumption of 32 watts. Manufacturer: Computer Control Co., Inc., Western Division, 2151 Buoy Ave., Los Angeles 64, Calif.



• Onufre Model 181A, designed to provide low distortion 1 mc. sine wave for electronic counters applies 1 volt rms output into 50 ohm load. Long term stability is 5 in 10 per week, short term is better than 1 in 10. Model is priced at \$700. Manufacturer: Onufre Inc., 1581 Page Mill Road, Palo Alto, Calif.



• Low temperature indicator, suitable for taped mounting and being held by hand, requires only infrared checks to compensate for changes in optical transmission after initial calibration. Radio section are available with field of view from one milliradian to 30 deg and can measure temperatures from -100C to 30C with a 1/10 accuracy for objects of known emissivity. Manufacturer: The Te Co., 411 E. Montebello St., Santa Barbara, Calif.



• Transducer/amplifier, Model 355/195-1 can be used in two ways: as a detector with a solid state amplifier, can convert forces into a signal which is amplified to 1 volt full scale. Unit measures 50 in x 100 mm weight 1.5 oz and is designed for aerospace applications. Manufacturer: Tiber Instruments Corp., 107 Constance St., North Tarrytown, N. Y.



MARTIN/BOAT TITAN I, shown above left, leaving and work of a launch site at Lowry AFB, is largest missile now in operational U.S. inventory. Above right, left stage is lowered into underground security launch site at USAF and contractors personnel stand by. Below left, ground stage follows test into site, where they will be tested by Air Force and civilian engineers. Below right, maintenance personnel, one of several assigned for each site, connects launch site with underground launch control center. USAF's Strategic Air Command recently assumed control of two Titan I complexes at Lowry.



AERIAL VIEW of USAF Titan I BORM complex near Lowry AFB, Colo., shows security of construction effort. When construction is completed, 37,100,000 cu. yd. of earth will have been excavated, and 2,647,000 cu. yd. of concrete and 742,000 tons of reinforcing and structural steel will have been utilized in constructing the BORM complex.

SAC Takes Control of First Titan 1 Units

By Larry Rood

Denser-In less than two months, two new weapon Titan I intercontinental ballistic missile squadrons have been transferred from the Air Force Strategic Air Command, which constructed the launching complexes and is developing the missile, to the 45th Strategic Missile Wing of the Strategic Air Command and declared operational.

At first, officials were, however, that there is a delicate difference between declaring the missile operational and having them in an alert status. This difference is reproduced mainly in the level of maintenance and launch crew training and is a lesser extent by each unit. Each of the units which AFSC has the responsibility to accept.

That such a difference exists is due to the principle of concurrent production that is applied to missile systems in the Air Force. All elements that have had anything to do with development, construction and operational deployment of the Titan I have been working together since the motor was received more than six years ago. The System Program Office is the final point and from the beginning in under control of AFSC.

At some point, there will be a determination as to when control of the system shifts from the development and building to the squadron. In the case of the Titan I squadron, where control center is located at Lowry AFB, control personnel conducted a formal status at each site.

Col. James P. Kelly, wing commander, has the responsibility for training and equipping the squadron. He has been caught between the external influences that press for alert status and the fact that crew training, although completed as much as possible, is not yet complete. There is no doubt that crew readiness will be achieved, but the amount of time now before that readiness has been reached has caused some internal discussion. These aspects are considered to be a growing pain, however.

The 45th Strategic Missile Wing is made up of two launch squadrons, a maintenance squadron and a logistics support squadron.

The 45th Missile Maintenance Squadron, commanded by Lt. Col. R. D. Lupton, is responsible for maintaining the missiles, the associated support equipment and the twenty to thirty-to-hundred nuclear.

Lt. Col. C. E. Macle, who commands the Wing Headquarters Squadron Section, is responsible for all administrative functions of the personnel assigned to the wing headquarters.

The 77th and 78th Strategic Missile Squadrons, commanded by Col. W. K. Gilbert and Col. G. V. Hennes, are the combat elements of the wing.

The weapon system which Col. Kelly must bring to full alert status and keep there is highly complex. Although the operational personnel are responsible for the overall status of the maintenance force that determines the absolute reliability of the system. Physically the wing is located at Lowry, at the same site of the Strategic Air Command, but the wing and all its elements are located there.

Special over the agreement given to the unit are the conditions which exist on the squadrons. Each squadron is equipped with three dramatic components: each one of which is a complete, self-sufficient control and launching installation. There are three sites, each with its own launch control center, two control sites, two sites for the alert crew, a power house, and connecting tunnels. All are underground.

A complex, extensive through supplies



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Two Light Gas Guns permit flight in hyper-velocity projectiles. Scientific studies of high-speed impact properties of solid gases, new alloys in development and deformation of gun and warhead materials are carried out.



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to last for 50 days without outside contact. This includes 150,000 gal of air and 100 kw of power. The power house contains four diesel generators, two of which are kept on the line at all times. One other is in standby status and another is in maintenance status.

A system of tunnels connects the interiors of the modules. A man-pass and means of gaseous flow ventilation permits fresh air. The atmosphere has the tunnels are built on a heavily noticeable dust, so that dust ac ions from outside have to be filtered out where the man has a guaranteed. The heated air goes to the surface in ducts, separating the normal flow. Only the power house has its own pressure ventilation system.

Guidance Antennas

The longest stretch of parabolic leads 1,200 ft from the area of the three missile sites to the two antennas also. These are the elements of the system that provide command radio guidance. If there two should be damaged in an attack, mission from an other complex could take over the guidance task.

Each missile in its also is kept loaded with RP-1 fuel. To prepare for flight, an automatic loading system is shown ready to load the missile with liquid oxygen. The total complexity here for Titan 1 from the signal to proceed is 15 min. First the liquid oxygen is loaded and the integral external guidance system is placed in final readiness. The count over the site, weighing 250 tons each, are opened and the missile is hoisted to the surface on a elevator. It is then ready for firing.

Over each launch in the Titan 1 development program involved a personnel unit of this sequence of a site and control complex at Vandenberg AFB, Calif in December, 1968. The crew had been making practice runs for some weeks preparing further on each until there was complete loading and lifting of the missile to the surface.

Site Destroyed

At the time of this incident, the countdown had gone to zero and the run was called off. The procedure then was to lower the missile into the site and check it. When the elevator battery was pressed, however, instead of lowering gradually, the elevator and missile plunged to the bottom. Not only was down the RP-1 and liquid oxygen in the missile, but more stored in tanks in the site. The sparks and vapors of fuel led to a ball explosion which immediately launched the site and most of the plumbing into the surrounding coral islands. As a result, a new site had to be constructed.

Hazat of the complex is the control

area, located 50 ft below ground. The control room and command area are separated by a wall, each equipped with a watch room 50 ft in diameter.

The missile control area commander sits in a separate room behind heavy glass.

Two technicians are also in the control to provide maintenance for the computer equipment.

Each crew, which stands a 24-hr shift of duty from seven to seven, is made up of the following:

One missile control crew commander, one guidance control officer, one missile system monitor, two missile operators (one supervisor technician, one missile system planner), one refrigeration equipment cooling operator, two missile electrical operators, and two electrical power production operators.

If calculations occur beyond the capabilities of the crew, help can be obtained from Losers. Other non-occupied crew members include two cooks and cleaning personnel.

Complex are located from 30 to 12 miles apart so that one single missile weapon could launch out more than one complex.

Complex missile launches are given 24 hours which are conducted at three Air Training Command bases. Most are given at Sheppard AFB, Wichita Falls, Tex., with others at Glenview AFB, Ill and at Lowry.

Vandenberg Training

The first team training for the Titan 1 crew is conducted at the 39th Missile Squadron of the 1st Aerospace Division at Vandenberg AFB. Each crew is assigned three launch training in individual skills and needs to be tested in teamwork.

The Strategic Air Command actually begins planning for the selection and training of combat missile crew and support personnel in 1975. Personnel SVC experience in planning to provide personnel for launch had shown that a lead time of 8 to 11 years was necessary.

This officer learned that his quick lead, for now the Titan 1 lead time has passed to be 5 to 6 years, the same as for the Atlas ICBMs. The Minuteman lead time will be even less. This is the result of improvements in development and production.

SVC had some background in planning what kind of men to assign to the new missile system. First was World War 2 experience had been accumulated in the handling and maintenance of nuclear weapons, for instance. High quality personnel were required to maintain missile, especially after jet entered the technology along with complex electronic equipment associated with navigation and bombing systems. The



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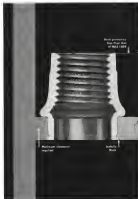
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FINANCIAL

Spacecraft, F4H Programs Point To New McDonnell Sales Records

By James D. Hendricks

New York—Government expenditures planned for the Mercury and Gemini manned spacecraft programs and the F4H Phantom strike aircraft would assure new sales records on each of the next three years for McDonnell Aircraft Corp., according to Thomas G. Rutledge, vice president and secretary.

Reporting a backlog of almost \$115 million as of May 15, 1962, Rutledge told a secret session of the New York Society of Security Analysts that if contracts now proposed for the Mercury, Gemini and Phantom programs are signed by Sept. 30, McDonnell will start a record backlog.

Rutledge told the analysts his company expects good sales and profits through at least the next four years, but two later months.

• **F4H**, already operational with the Navy and scheduled for Air Force use under the F110 designation, will be the dominant U.S. strike aircraft during the next four to five years.

• **McDonnell** is the only U.S. company with an operational manned space vehicle at the time and should hold that advantage for at least another three years, Rutledge said.

National Aeronautics and Space Administration contracts awarded to McDonnell for the Project Mercury spacecraft total about \$145 million to fit the company's initial order and McDonnell will not complete its work on that program until sometime, 1963. First advanced Mercury man-in-space spacecraft will be built for NASA's projected 15-orbit flights, and these vehicles will be capable of a use in training future spacecraft for space flight or for unmanned reconnaissance launches.

Genie Work

This, too, has been so demanding that it is the ultimate test of any aerospace work, but it should develop into at least double the dollar volume of our Mercury work, Rutledge said. "The present requirement is for 12 Gemini (two-man) spacecraft, each of which will weigh two or three times as much as the Mercury man-in-space vehicle, have 50% more cubic feet of cabin volume and be capable of orbital flights of a week or longer."

Rutledge remarked that McDonnell's "experience in design, construction and flight testing of six highly complex vehicles

for USAF's Project ASSET (Advanced Astronautics Structural System Environment Test) "has great potential and will lead into excellent lines of future business."

Commenting on the F4H, Rutledge said that last month the company is covered an advance order of 31.7 million for engineering, tooling and mock-up work on the USAF F4H and that there is a high probability that the first contract for a reconnaissance version—the RF-119—will be signed in the near future, Tucson, Arizona. Departing next is Fiscal 1963 budget provides for 250 F-110s and 25 RF-119s.

Funds for these aircraft total about \$580 million, and over 60% would be awarded for McDonnell contracts, Rutledge said. The contracts are scheduled for negotiation next month and are due to be signed by September. USAF and Navy have planned to fund all five variants of the Phantom in their Fiscal 1964-65 budgets. Rutledge told the analysts he added that McDonnell is exploring the possibility of selling F4H aircraft to air forces of all other North Atlantic Treaty Organization nations.

Financial Status

Discussing the company's financial status, Rutledge said the situation during 1962 is expected to be based on results achieved during the nine months ended May 31. Sales amounted to approximately \$225 million, 7.1% higher than the comparable 1961 period. Net earnings rose 9.7% to slightly more than \$10 million, tops for any comparable period in the company's history. For the nine months ended May 31, 1962, operating profit was \$1.96 compared with \$1.63 of the same time last year and the last quarter of the current fiscal year should add about \$1.06 per share, Rutledge said.

The company is free of any debts, and working capital has reached a record of more than \$80 million, he added.

While attributing the major credit for this advance to the Phantom and F4H programs, Rutledge pointed out that other areas have paid off for the company, adding:

- **Good drop inside.** Delivery to the Air Force will end next month, but engineering, modification and support business will continue for at least two more years.
- **Take rank.** Contracts to date for the

CRYOGENICS Refrigerator- Liquefiers



At the present time CRYGENCO is building three hydrogen refrigerator liquefiers for association with bubble chamber research. Cryogenics engineers have had major responsibilities for production of five of the six largest hydrogen refrigerator liquefiers designed for bubble chambers in the free world. Liquid hydrogen refrigerators liquefy gases at storage liquid points at 10°K, lower than for stainless steel and space vehicle environmental modes in 16K, as well as for bubble chamber operation in portable installations. Production of refined gases include nitrogen liquefier, high pressure nitrogen liquefier, refrigerant gases, low temperature chambers, independent nitrogen catalyst, etc. Free your physical and chemical needs for the world's most advanced equipment. Let Cryogenics engineers design and build your custom equipment meeting your exact requirements. Write Cryogenics for full details on these low temperature high vacuum capabilities and experience.

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surface-to-air Navy jet's surfaces and integrated radar engines amount to more than 350,000 man-hours, work should continue for several years. Development of the Typhoon, an improved version of the T-45, could push this business beyond Fiscal 1986, according to Haggerty.

• **Aircraft assembly.** Contract work is under way with the Army on a sophisticated heavy battlefield assault, Haggerty said. Other work is scheduled while development could pay off for the company in the near future, according to Haggerty.

• **Automation and electronics.** These divisions will develop more than 530 million in business this year, Haggerty said. The Electronic Systems Division, established in January 1963, has more than 60 sites in production and 36 support programs under development in guidance and control,

space communications and aerospace ground support equipment. The Automation Center's experience in consulting, systems design and technical programming should ensure its continued growth, he said.

• **Spares and technical services.** Sales show in spares, technical data, kits and services should exceed last year's figure of \$61 million, which represented about 12% of McDonnell's total sales, Haggerty said. This work, much of it covered in spare production contracts, must have continued support of current and completed production runs, such as the F-101 Voodoo and F-4H Phantom II.

McDonnell's research and development expenditures total about \$70 million annually, Haggerty said, limited to new product proposals. "It's all non-recoverable," he added, "but it's definitely not in any tighter situation."

men in whose sales of more than \$1 million annually have been made from 1975 to 1980 to 45, less said.

• **A three-linear manufacturing cycle** from start to test is being experienced as TT's new silicon diode, the Mesa/G, is now tested in the 6 box size. 10-sec digital computer is demonstrated for October (AW Oct 23, p. 18), are selling in volumes of thousands monthly, Haggerty reported.

BAC Reports Profit On Merged Operations

London-British Aircraft Corp. made a 1963 profit of \$4.5 million from about 550 million Manxair at the Royal Air Force Lord Port of Harrogate, BAC chairman, told stockholders recently.

Total sales amounted to \$225 million, the \$30 million on which the profit is based were new projects started since British Aircraft Corp. was formed by merger. BAC includes the aircraft and guided weapons activities of British Aircraft, English Electric, Armstrong, Whitworth, Armstrong, (Avon), and Hunting Aircraft.

Referring to the weapons business, Lord Portford created formation of a joint BAC/Financ Engineering Co. firm to develop what he called "variable pitch" wings involved in the Financ Swagelok wing tank company, as first reported in Aviation Week (AW Jan 8, p. 22).

The corporation now has \$784 million on its order books. In a progress report Lord Portford pointed out the following:

- **Considerable portion of BAC design and development expenditure** is being taken up in the 1963-64 fiscal year by the Royal Air Force through a joint British-English Electric design team.
- **Deliveries of English Electric T-4** two-seat Lightning jets by RAF have started and deliveries of the F-4A version have been completed.
- **First jet-day research aircraft**, the P-126, being built at Luton under Ministry of Aviation contract, is well advanced and will fly this year.
- **Extension of BAC variable geometry contract** (AW Apr 9, p. 36) is under discussion with the Ministry and Lord Portford confirmed Aviation Week reports that the contract is part of an east German-BAC-McDonnell TV design for the North Atlantic Treaty Organization's VTOL competition.

Lord Portford said a total of 53 million has been received on the private venture, which development of the variable BAC-111 twin jet transport. He said a total of 21 orders has been placed, including eight with an aircraft which does not wish to be named.

Texas Instruments Officials Vote First Cash Dividend Since 1953

Dallas, Tex.—Texas Instruments, Inc., declared recently the first cash dividend on its common stock since the shares were listed on the New York Stock Exchange in 1953. At the annual meeting of TI's board of directors, the company voted an initial quarterly dividend of 10 cents per share of common stock to be paid on or before May 1. The company has \$245,415 shares of common stock outstanding.

The company had indicated in past years that it preferred to plow back earnings into expansion and research programs and longer common stock and dividend policies in TI. James H. TI board chairman, in announcing the new dividend policy, indicated that the company's strong financial condition permitted directors although research and development and expansion expenditures will continue at a high level. The company has been under some pressure to initiate such a policy or provide a stock split in the past several years in view of the downward trend of TI stock prices on the market from a high of 26 1/2 in 1950, the trend has been down to a high of 106 in 1960 and a high this far this year of 115 1/2. Price of that stock was \$21 prior to announcement of the new common stock cash dividend policy.

Heavy competition in the components industry and large increases in costs of labor and research and development have not seriously lessened earnings of various components manufacturers, and adding TI President F. E. Haggerty told company stockholders here that TI sales and earnings for 1962 should be considerably higher than for

1961. In reporting first quarter earnings for the current year, Haggerty stated that earnings after taxes were \$2,411,080, equal to 60 cents per share, on sales of \$10,483,000. Net earnings were \$1,775,000 or 45 cents per share on sales of \$5,977,000 for the same period last year. He noted that fourth quarter 1961 net earnings totaled \$2,183,000 or 54 cents per share on sales of \$6,256,000. TI realized a net profit of approximately \$1.4 million on sales of \$273.2 million in 1961.

Discussing competitive pressures, Haggerty noted that last year TI shipped more than 45% more physical packages than in 1960 for particularly the same sales dollars and with less than 5% increase in cost. In the first quarter of 1962, TI's physical volume across the company was 15% higher than the 1961 average.

Tax Rate

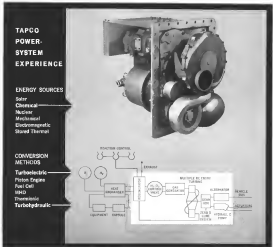
Since a larger proportion than usual of TI's last quarter earnings this year reflect overseas operations and where lower tax rates prevail, the overall tax rate was more favorable than before and profit after taxes in the first quarter represents a return of 4.2% on sales.

Highlights of TI current operations reviewed by Haggerty include the following:

- **Strike News** autonomous mode (AW Mar. 12, p. 121), for which TI is a prime contractor, operates on a contract for the company in construction of the autonomous mode.
- **Sales in south America**, including solid state physics, geophysics, oceanographic and space sciences, has shown an increase in the number of con-



POWER SYSTEMS BY TAPCO—Combining extensive energy conversion experience with a high degree of interface systems intelligence, Tapco insures that trade off studies will yield the most practical power system in terms of specific weight, reliability and operational feasibility.



Energy Requirements: After Chemically stored energy, the most efficient system is the electric and hydraulic pump, reaction control and environment control (space) board mainline space vehicles on moderate duration missions. System is easily adaptable for outputs to 100 kw electric and 2000 hp hydraulic. Module of system is and shown shows containing multiple to entry before allowable hydraulic pump, intermediate and con-

tinuous systems. Turbine drives liquid H₂ and O₂ as energy source. By using H₂ as coolant, and exhaust conversion may be specific propellant consumption is achieved. Integration of energy source that provides all payload cooling (i.e., waste heat and capsule). Performance of all systems elements has been demonstrated. Tapco, a division of Thompson Ramo Wooldridge Inc., 23955 Enclave Avenue, Cleveland 12, Ohio.



HES REDUCING THE COST OF AN ENGINE OVERHAUL

It is customary for overhaul shops to use a vapor blast to clean the baked-on carbon from turbine engine blades and discs. This is a slow process. The material to be reamed resembles a very tough varnish. Every bit must be removed from the surface of the metal so any cracks present will be easily visible. But slurry covers up the work; the operator works blind; the danger of crating the metal beyond maximum limits is great.

Airwork looked for a better way—and found it in the dry boner used in an allied industry. This proved to be not only faster—but gave the operator a constant, un-

obstructed view of the work. The result—less chance of metal erosion—and a better inspectable surface that makes metal flaws easier to spot.

This is one result of our constant effort to reduce costs while increasing reliability. It saves many labor dollars on a Dart engine overhaul... and will soon be saving money on piston engine overhauls, too.

There are over 55 Airwork dealers East of the Mississippi who sell and service Airwork overhauled engines. This organization, the largest of its kind, includes every major fixed base operator in the East... one more good reason to buy and fly Airwork.



**ESSENTIAL AVIATION
SERVICES**

Airwork
CORPORATION
Bridgewater, New Jersey

BUSINESS FLYING



PIPER-HENKEL CM 191. Here a pilotless test flight at Hannover Air Show. A two-place, turboprop, 1000 and 1200 models developed by Piper West German industrial team. Aircraft is powered by two Turbomeca-Mahle 6 turboprops delivering 1050 lb. static thrust each. At Hannover, government permitted only two 30-min. flights per day with pilot and second pilot as mechanic aboard.

Hanover Features CM-191 Demonstration

By Herbert J. Coleman

Hannover.—Piper-Henkel's CM-191 was four-place turboprop jet (AW 75 p. 103), was flown publicly for the first time last week at the Hannover Air Show. Europe's business through-the-air.

Customer demonstration, however, not much disrupted by a German jet fueling the company to do the CM-191 with more than two persons aboard, one pilot and a passenger holding either a pilot's or engineer's rating. Other training was that the CM-191 had only 30 hr flight time and this was an experimental plane.

In addition, the CM-191 was limited to two 30-min. flights per day. They were made time intervals placed on the show's order jet a Lockheed JetStar from a Hannover jet, Jacqueline Ochs car.

In the turbofan flight, engines displayed were the Pater 540 (AW Dec. 25 1983 p. 70) and the Sikorski Marquis (AW Dec. 14 1983 p. 147). Second Pater 540 will still not in two weeks at the first flight scheduled for the end of May.

The HAWK Aircraft, which sold two Pater 540s at the show—two to the German Institute for Flight Safety, and the other to the Republic of Ireland—also revealed new interior arrangements of ex-DH 125 aircraft jet making a strong pitch for a share of the military market.

First DH 125 is on the flightline for

and will make its first flight in August. One customer change has been made by adding 5 in. to the vertical fin for increased area and stability. The company said deliveries will start at the end of 1983; initial investment will be 30 million.

Military Version

The military version has been offered to the Royal Air Force on the basis of a potential 50 plane order and the Hawk land also is presenting a similar version to West Germany with the cockpit fitted with Lockheed F-104G cockpit simulation.

Military versions consisted for the current include:

- **European turboprop jet** fitted with an electronic and two seats, stressing DH 125 rough field capabilities and operating characteristics which allow it to operate fields down to 4,500 ft long for takeoff and landing.
- **German jet** which includes a television camera in the tail, for landing the engine over cloud cover to sight the start.
- **NASABR** (North American Search and Radar) (AW Dec. 25 1983 p. 147) fitted with a radar and a searchlight, by extending the nose for more equipment. Four seats are added around the cockpit.
- **Navigation and radar** which could be added along with a ground display for training pilots who are converting to larger jet transports.

Britain's Bregue Aircraft Co. will be not with production problems as its 700th anniversary, did not show the plane at Hannover although two have been built. The first production model has been modified by lengthening the wingspan to 42 ft and increasing cabin size to permit width of 62 in. and height of 72 in.

Considerable interest was shown in the Bregue Aircraft Co. 2, generally due to its glider capabilities. Its model, that was three other ones, for the Mark 2 demonstrator. All were turned down because of the Bregue policy of selling airplanes not their design and service facilities have been set up in the customer market.

U-18 Appearance

Among the line of business business aircraft for the first time was the U-18, a 18-seater, now making a strong market Europe and Scandinavia markets to generate interest for future sales. Jim Cox of Piper-Rever, Inc., who is representing U-18 on the line, said the European distributor will be the Euro of Pinnerd College.

Pinnerd U-18 delivery data to European customers have not been worked out, pending final arrangements for production in France. (For other detailed coverage of last week's Hannover Air Show, including European design studies presented there for the first time, see p. 101.)



WAR

PEACE

AERONCA ... and the 15-minute* man!

The key to peace lies in the nation's detested power ... the building and maintaining of the military strength requires to provide enemy aggression here or abroad. Today, Aeronca's DEFENSE PRODUCTS GROUP is making significant contributions to the nation's readiness, delivering systems and subsystems to meet the sophisticated requirements for advanced air weapons, electronic and ground support equipment. To produce complete systems packages, Aeronca's Scientist team with computer Project Engineers to evaluate and analyze mission profile requirements ... interpret abstract concepts ... develop and produce operational systems. And Aeronca offers performance-proven systems management with integrated telecommunications and facilities to assure Quick Reaction Capability ... expedite projects from the theoretical-problem stage through the production of actual working hardware ... reliable and on-schedule!

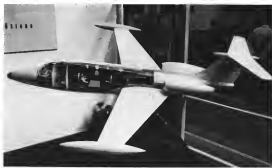
*These keys were by an officer of the U.S.A.F. and R.A.F. control. These projects based on Russian language in various control panels, also keys were a lucky coincidence 15-minute contribution to military war.



manufacturing corporation
1714 Commercial St., Indianapolis, IN

Excellent drawings and models for civilian & B-2 business with complete facilities. Also key to be safety factor. Key: Production Engineering

PLANTS ARE LOCATED FROM COAST TO COAST: ALBUQUERQUE, N.M.; BIRMINGHAM, AL.; BOSTON, MA.; BRIDGEVIEW, ILL.; CHICAGO, ILL.; DAYTON, OHIO; DALLAS, TEXAS; DETROIT, MICH.; EL PASO, TEXAS; HARTFORD, CONN.; HONOLULU, HAWAII; KANSAS CITY, MO.; LOS ANGELES, CALIF.; MEMPHIS, TENN.; MILWAUKEE, WIS.; MINNEAPOLIS, MINN.; NEW YORK, N.Y.; PHOENIX, ARIZ.; PITTSBURGH, PA.; RICHMOND, VA.; ST. LOUIS, MO.; TAMPA, FLA.; WASHINGTON, D.C.; WICHITA, KANS.



HAMBURGER FLUGZEUGBAU HFB 320 executive jet shown in model form has 15 deg. forward wing sweep and high T.O.D.

German Jet Aimed at Business, Airline Use

Hamburg-Hamburger Flugzeugbau's planned entry into the already crowded executive jet arena, the HFB 320, also is being promoted for potential military and feeder-line markets, with a tentative first flight date and subsequent sales date for the 6 to 14 place aircraft set for the second half of 1981.

Hoping to expand its own operations? too, and at the same time broaden the scope of the West German aviation industry as a whole, the company recently appeared the opening of private funds for production of prototype models and subunits for drive testing. Construction of a full-scale full-powered mockup is nearing completion, and detail design is well under way.

The aircraft to be powered by two turbofan engines mounted front & rear, HFB 320's intended engines of 3,800 lb. thrust each (AW Apr. 27 p. 185) equipped with direct reversers, adduced roughly to the external appearance of a number of other, although generally smaller, projects, already announced with a significant difference—the wing, with a span of 45 ft 10 in. and an aspect ratio of 6.5, has a 15 deg. forward sweep.

Forward or aftward sweep is such has been under study by the National Aeronautics and Space Administration for a number of years and, according to reports here, promises some aerodynamic advantages over conventional sweep. Its principal drawback, and one

that has made U.S. manufacturers wary of its adoption, is the need for exceptional strength in order to handle the buffet and gust loads it would encounter in this configuration.

Wing benefits

Hamburger Flugzeugbau, however, contends that its wing entails no particular design hazards and will provide a number of benefits, including fuel savings effectiveness over the entire speed range.

A major reason behind the decision to adopt forward sweep was the desire to position the passenger and baggage compartments completely forward of the wing in order to avoid pouring the mass over the cabin area. Superimposing the reasons behind the wing plan is computer design study results.

The chief is fully utilized for carrying as none of the wing parts intrude upon it, a given cabin cross section provides the maximum standing height as, moreover, a given standing height provides a maximum cabin cross section. The mid-wing (provided) a five-mile drag profile (and wing root bending between aileron and fuselage is virtually eliminated at this rate. When compared with the high-wing configuration, the HFB 320 wing layout gives better flight characteristics and lower trim drag due to a lower center of gravity. The wing is further off the ground than low wing types to improve co-

Hamburger HFB.320 Specifications

	Std. Plan	Function Plan
Wing span	45 ft. 10 in.	45 ft. 10 in.
Length	40 ft. 10 in.	39 ft. 10 in.
Height	13 ft. 3.5 in.	10 ft. 3.5 in.
Empty weight	8,500 lb.	8,700 lb.
Fuel and oil	6,540 lb.	4,794 lb.
Ops.	480 lb.	397 lb.
Fuel tank	8,020 lb.	2,840 lb.
Useful load	7,820 lb.	7,520 lb.
Takeoff weight	16,914 lb.	16,914 lb.
Cruise speed	961 mph	915 mph
Range (w/standard)	3,881 mi.	792 mi.
Takeoff distance (w/ 60 ft.)	3,560 ft.	2,160 ft.
Landing run	881 ft.	1,020 ft.



hallicrafters

Sails Into "the New Ocean"* of Aerospace Electronics!

Hallicrafters Quick-Reaction Capabilities Have Been Expanded in Four Important Ways:

1. The highly-respected scientists, engineers, management and facilities of *Merson Laboratories, Inc.*, Stamford, Conn., have joined the Hallicrafters "family." This new subsidiary enlarges our capabilities in military communications.
2. Hallicrafters Aerospace Division is concentrating its well-known QRC forces in this broad field. The Division reflects the expansion of work and responsibilities in an ever-widening variety of assignments.
3. A specialized electronics research staff has been established in the Los Angeles area, to serve Air Force missile activities on the West Coast.
4. Hallicrafters is participating in a new R & D and manufacturing facility to be built in Chicago, for high-power microwave tubes and vacuum devices.

Among HALLIGRAFTERS current assignments:

- Missile deception and decoy systems.
- Missile tracking systems (Ball Missile Range); aerospace ground equipment; ground checkout systems; simulators.
- Electronic Counter-Measures equipment systems for bomber and fighter aircraft; search and track; ECM reconnaissance systems; ECM simulators.
- Radio Frequency Interference measurement and reduction components.
- "Blue Flash" Projects (field electronic technical support).
- And of course, many other classified programs.

*The phrase was struck by President John F. Kennedy February 25, 1962, as he commended new Hallicrafters engineering talent John B. Gann, Jr., back to Earth.

This special photograph was taken through the window of a high altitude balloon. It is a 35 mm color print. The Moon appears in a special light through a camera lens, and if you wish, you can see it.

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50-CONDUCT RECEIVER—Performs transponder for Avionics missile tracking equipment, furnishing precise frequency data. Built for General Systems Applications.



CODE TRANSLATION SYSTEM—High-speed digital data set confirms transmitter and receiver at one unit. Used for Technical Bulletin (JAN 121 and 122).



REFERENCE STANDARD—Creates a time reference standard with a precise and stable signal in the 400 mc. region. It is part of the ground instrumentation for the Nike missile program.

The new ideas in aerospace electronics are born at...

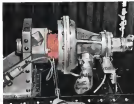
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Circle 10 on Reader Service

GENERAL ELECTRIC RTV SILICONE RUBBER KEEPS THE PRESSURE IN THE X-15!



Critical pressurized areas of the X-15, designed and built by North American Aviation through a joint NASA Air Force Navy aerospace project, are sealed with General Electric RTV (room temperature vulcanizing) silicon rubber. After a close up analysis of all high temperature seals, RTV was selected to seal the aft bulkhead behind the cockpit, environmental sensor compartment and shoring near the ship's main cabin.



RTV adhesive seals forming airtight seals for helium pressure regulation. RTV rubber forms tremendous bonds in most materials (except vulcanized surfaces are properly prepared). It is easily removed from unpainted surfaces. It can be applied by dipping, pouring, spraying or brushing—clean in place at room temperature to form a tough, flexible seal. Cuts tapes can be varied from mils to inches depending on catalyst used and heat, if applied.

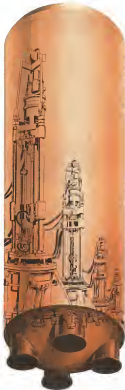


Protectors against hydrogen peroxide spills are provided by RTV silicon rubber coating on the three piston actuators. RTV is commonly used to protect against moisture and many chemicals. It's used in almost all U.S. missiles and space vehicles, not only for sealing, but for electronic potting and encapsulating, and as thermal insulation. It maintains excellent electrical properties with physical protection.

If you would like a free sample for evaluation, write us your interest, describing your application. Service (266), Silicone Products Department, General Electric Co., Waterford, N. Y.

TYPICAL PROPERTIES OF RTV SILICONE RUBBER

	RTV 11	RTV 30	RTV 40	RTV 45	RTV 55	RTV 60	RTV 65	RTV 66	RTV 67	RTV 68	RTV 69	RTV 70	RTV 71	RTV 72	RTV 73	RTV 74	RTV 75	RTV 76	RTV 77	RTV 78	RTV 79	RTV 80	RTV 81	RTV 82	RTV 83	RTV 84	RTV 85	RTV 86	RTV 87	RTV 88	RTV 89	RTV 90	RTV 91	RTV 92	RTV 93	RTV 94	RTV 95	RTV 96	RTV 97	RTV 98	RTV 99	RTV 100	RTV 101	RTV 102	RTV 103	RTV 104	RTV 105	RTV 106	RTV 107	RTV 108	RTV 109	RTV 110	RTV 111	RTV 112	RTV 113	RTV 114	RTV 115	RTV 116	RTV 117	RTV 118	RTV 119	RTV 120	RTV 121	RTV 122	RTV 123	RTV 124	RTV 125	RTV 126	RTV 127	RTV 128	RTV 129	RTV 130	RTV 131	RTV 132	RTV 133	RTV 134	RTV 135	RTV 136	RTV 137	RTV 138	RTV 139	RTV 140	RTV 141	RTV 142	RTV 143	RTV 144	RTV 145	RTV 146	RTV 147	RTV 148	RTV 149	RTV 150	RTV 151	RTV 152	RTV 153	RTV 154	RTV 155	RTV 156	RTV 157	RTV 158	RTV 159	RTV 160	RTV 161	RTV 162	RTV 163	RTV 164	RTV 165	RTV 166	RTV 167	RTV 168	RTV 169	RTV 170	RTV 171	RTV 172	RTV 173	RTV 174	RTV 175	RTV 176	RTV 177	RTV 178	RTV 179	RTV 180	RTV 181	RTV 182	RTV 183	RTV 184	RTV 185	RTV 186	RTV 187	RTV 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938	RTV 939	RTV 940	RTV 941	RTV 942	RTV 943	RTV 944	RTV 945	RTV 946	RTV 947	RTV 948	RTV 949	RTV 950	RTV 951	RTV 952	RTV 953	RTV 954	RTV 955	RTV 956	RTV 957	RTV 958	RTV 959	RTV 960	RTV 961	RTV 962	RTV 963	RTV 964	RTV 965	RTV 966	RTV 967	RTV 968	RTV 969	RTV 970	RTV 971	RTV 972	RTV 973	RTV 974	RTV 975	RTV 976	RTV 977	RTV 978	RTV 979	RTV 980	RTV 981	RTV 982	RTV 983	RTV 984	RTV 985	RTV 986	RTV 987	RTV 988	RTV 989	RTV 990	RTV 991	RTV 992	RTV 993	RTV 994	RTV 995	RTV 996	RTV 997	RTV 998	RTV 999	RTV 1000	RTV 1001	RTV 1002	RTV 1003	RTV 1004	RTV 1005	RTV 1006	RTV 1007	RTV 1008	RTV 1009	RTV 1010	RTV 1011	RTV 1012	RTV 1013	RTV 1014	RTV 1015	RTV 1016	RTV 1017	RTV 1018	RTV 1019	RTV 1020	RTV 1021	RTV 1022	RTV 1023	RTV 1024	RTV 1025	RTV 1026	RTV 1027	RTV 1028	RTV 1029	RTV 1030	RTV 1031	RTV 1032	RTV 1033	RTV 1034	RTV 1035	RTV 1036	RTV 1037	RTV 1038	RTV 1039	RTV 1040	RTV 1041	RTV 1042	RTV 1043	RTV 1044	RTV 1045	RTV 1046	RTV 1047	RTV 1048	RTV 1049	RTV 1050	RTV 1051	RTV 1052	RTV 1053	RTV 1054	RTV 1055	RTV 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HAND IN HAND

HIGH STRENGTH COMBINED WITH TOUGHNESS

... New MARYAC (Moving) steels by Latrobe. Failure of a component in a missile or jet aircraft can mean failure for the entire system. That's why optimum performance in high strength structural applications and critical loading calls for alloys possessing the ultimate in quality.

The newest concept in ultra high strength metals is the remaining steels developed by International Nickel and being produced by Latrobe Steel under the trademarks *Marex-18*, *Marex-18A*, and *Marex-20*. These low carbon non base alloys contain 18 to 20 percent nickel plus important alloying additions. Besides their unusually high strength and toughness they show remarkable ductility under extremely high stress concentrations, far superior to 16-11 and 4340 types.

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defense bases in use with the others of the North Atlantic Treaty Organization. Earlier, Ernst Heinkel Flugzeugbau revealed its plans to try and penetrate the short-haul airline market with two aircraft, one a turboprop and the other a turboshaft (AVF Apr. 30, p. 41).

Both programs also stem from a 1918 resolution by the Ministry of Economics requiring West German firms to develop plans for civil aircraft. The Heinkel turboprop is almost follow-on to projects submitted at that time, the HFB 310 as an offshoot. Ministry hopes of financing the more promising projects submitted during the competition failed to materialize, but both firms continued their development work in the civil field.

Heinkel's Flugzeugbau originally had planned to enter the medium-range turboprop market with a 70-passenger Mach 0.8 design designated the HFB 314 but, as other aircraft appeared on the competitive scene and federal funding remained elusive, it abandoned its stand. The end result was the HFB 320.

Competitive Position

Although competitors here also promise to be able to beat the German firm out it is "assumed" that the ultimate demand for such an aircraft will make the project worthwhile.

The HFB 320, it adds in explaining its take concept, will be capable of carrying "one more than could be purchased by a businessman in one day. It is also particularly suitable for charter to tourists. It can be used for freight service, as an office or high frequency service, as a mail cargo unit, or, in a transport as a multi-purpose military aircraft."

To permit its utilization as a cargo carrier, the forward passenger entrance is being designed with dimensions of 14 ft by 27 in. The conventional jet cycle landing gear will be equipped with low-pressure tires to permit road runs in expedient.

The passenger cabin within the circular fuselage contains forward and rear baggage compartments that are accessible in flight. The cockpit, passenger cabin and baggage holds are pressurized to provide a constant internal pressure of 5,000 ft at a flight altitude of 16,000 ft. Maximum cabin width is 62 ft, standing height is 57 ft.

Maximum fuel load is 6,545 lb stored internally in the wings and in two wing tanks that will be provided in standard equipment. Hydraulic system, supplying a normal pressure of 2,957 psi, operates the landing gear, flaps, wheel steering unit, brakes, flap spoiler and slats. Electrical power for the main lights, radio and other instruments is supplied by two 20 kw alternators.



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NAVION RANGEMASTER 1962 retains basic Navion configuration, but achieves distinctly look by addition of cantilever tip tanks and redesigned cowl. Door has optional sliding canopy. Engine now is 200 hp. Continental IO-470-B.

Aviation Week Pilot Report:

Modifications, More Power, Give New Life to Navion

By William S. Reed



NEW INSTRUMENT LAYOUT places dual gauges and cluster switch on overhead panel.

Long Beach, Calif.—Extensive modifications and increased power added to the basic Navion airframe of the classic three-seater plane has resulted in a fast, low-handling light aircraft with room for five passengers and a cruising range of 1,475 mi.

Production of the 1962 Rangermaster by Navion Aircraft Co. of Galveston, Tex., goes new life to the design originated by North American Aviation and later produced by Ryan Aeronautical Corp. until 1952. Basic design and structure of the Rangermaster retains the Navion wing, landing gear and basic fuselage outline but beyond that, the aircraft has undergone major changes.

Performance has been increased by the installation of a Continental IO-470-B air cylinder, fuel injection engine developing 200 hp and turning a McCulloch constant speed, hydromatic propeller. The Rangermaster's wings is 1,875 sq ft, 7,300 ft on 6570 power and the aircraft has a maximum sea level speed of 194 mph, at maximum continuous power.

The Navion Rangermaster is supplied



DOOR CUTOOUT enters partially open cowl and. Sliding and retract in stream flap provide steps to wing.

with an aircraft rather than an overhaul or work of an old aircraft. The familiar sliding canopy entering a low place when has been fixed over and a large entrance door placed on the left side. One step and one retract on ground in the flap in steps. Flaps have been moved to allow them to be used in steps.

Included in the basic price of \$25,900 is exterior paint in a variety of colors, interior trim and upholstery, full instrument panel, night lighting, etc. Only optional equipment must be purchased at extra cost for the Rangermaster. The aircraft flown by Aviators, Wren of Western Navion, Inc., West Coast distributor, was equipped with Mustangs A280, Viper, and basic equipment, bringing the price of the craft to \$28,500 complete. Included at no extra cost is most of the features offered as options by other manufacturers. Also marketing of the Rangermaster was Western Navion's general manager Dave Condit. Most light aircraft have the factor at a low control price but when the customer adds up the options needed to make the aircraft usable, the price often is \$5,000 more than the basic price. The



HYDRAULIC GEAR design incorporates pressure release system for fuel tank gear lowering.

Until
aircraft
are
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When fire detection is an afterthought, everybody pays: builder, operator, and passenger. False alarms, redesign "fixes" and general inconvenience have given this vital safety system a bad name. Why?

Too often fire detection is an afterthought. The engineer must "fiddle"—rather than "design it in."

Systems are chosen without knowing how they will perform. Components are located where they do little good—or are inherently subject to damage. But this need not be.

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experience can improve your detection system. Because only Fenwal has a complete line of proven detection equipment, we can give you absolute objectivity and recommendations based on a solid experience foundation. Don't call us for more information. Fenwal Incorporated, 126 Pleasant Street, Ashland, Massachusetts.

Fenwal

Rangerstar, in most cases, has a lower delivered price than similarly equipped competing aircraft despite a starting quotation which may be higher.

The Rangerstar still retains the familiar Navion lines, the most prominent of which is a long tail moment area. Exposed surfaces of the aircraft are proportionally smaller than those of most light aircraft because of the distance from wing to tail. The result on the Rangerstar has been modified to include an aerodynamic counter balance at the top which reduces rudder pedal forces considerably.

Tip Tanks

The centerline-mounted tip tanks make the Rangerstar readily driveable from either Navion. Each tank holds 34 gal and fuel is fed independently from each tank to the engine. A selector switch controls tank selection and each tip tank, as well as the main system of two wing tanks, is equipped with a fuel gauge. Tip tank fuel is not used for landing or taxiout and a placard states that fuel from the tip tanks is to be used in level flight only.

Exhauster says the cockpit is facilitated from the left side by a large exhaust extending partially into the roof of the cabin. There are no significant color contrast appointments except for color but quality appears in contrast with the typical "de-luxe" look of light aircraft. Individual seats and headrests are supplied and each seat is equipped with individual reading lights and air vents similar to those found in airplanes.

Overhead Panel

Electrical switches, fuel gauges and master switch are located on an overhead panel leaving the main panel free from clutter. Throttle, propeller control and fuel pressure control—the latter replaces a mixture control on fuel as it permits engine—idle or richer operation. A button on the knob allows the varnisher to be changed, whereas a

Navion Specifications

Fuel capacity (gal)	
40 gal. main tank 34 gal. each tip tank	108 gal.
Engine, Continental IO-470-B4	240 hp
Prop	180/130 (2-stage)
Length	27.4 ft.
Height	5.5 ft.
Wing span	34.5 ft.
Wing area	154.5 sq. ft.
Weights	
Maximum takeoff	3,115 lb.
Maximum landing	3,215 lb.
Empty	2,008 lb.
Service load	3,121 lb.
Baggage compartment	140 lb.
Maximum outside load	3,049 lb.



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3. This turbine-type CECO valve is used on conventional jet aircraft to control the flow of air in cooling air-fuel systems.
4. A "tailored" CECO fuel control and pumping system used on the Ryan Q-3C target missile.

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Los Angeles Operates Fire Helicopter

Bel-401B helicopter owned by Los Angeles County Fire Department has been fitted with 200 psi tank to enable it to "bush" fires with high degree of accuracy.

With the heel of the hand pilots can be advanced rapidly. Advancing or retarding any of the three functions is done by rotating the handle and while this is acceptable for gas and fuel pressure control, throttle operation proved cumbersome for this pilot, especially during taxi.

Taxiing is accomplished through a steerable nose-wheel linked to the rotor pedals and the high pedal forces required for sharp turns are eased by applying right braking pressure. Valves in good for all ground operations.

Control during the takeoff run is easily maintained with rudder pedal employing a combination of nose wheel steering and rudder. No sharp transition is observed as the nose wheel leaves the ground. Climb rate is only at 100 mph. 145 with 25 in. manifold pressure and 2,500 rpm. Initial rate of climb observed was in excess of 1,200 ft. per sec. at a gross weight of 1,000 lb.

Over the nose visibility is not necessarily compromised during climb as the Rangermaster became of the sharp down ward slope of the nose forward of the windshield. Visibility to the side is somewhat limited by the cabin roof but not so much in a high-wing aircraft.

Landing gear and flap on the Rangermaster operate hydraulically and once the wheels are cleared up after takeoff pressure on the hydraulic system is relieved by pressing in the hydraulic power lock. Because hydraulic fluid temperature, and the loss of fluid should a leak occur, there is no clearance. A similar system is employed on the Nike Apogee T-6 with the exception

that the power button returns to the off position on a time delay line. In event of hydraulic failure in the Nimrod, a hydraulic system detector is used to advise pressure in the landing gear to prevent collision and the gear free-falls into the down-locked position in return of the splash. A hand pump is installed to insure flap in the event the double failure is caused by a faulty pump.

Climbing speed is checked by level flag the Rangermaster at 2,600 ft. and allowing the airspeed to combine with the pump set at 24 in. and 2,400 rpm. Fuel pressure is set at the desired value according to the gauge, in five case 9 psi for 74% power. Indicated air speed is set at 350 mph, which is set to 171 mph true airspeed. Advertised true speed of the Rangermaster for normal cruise is 151 mph at 7,500 ft. Fuel consumption at the setting is 11.13 gal/hr. Although not tested on Apogee T-6's engine, fuel consumption is 50% power at 12,000 ft. using 2,400 rpm and 16.4 in. manifold pressure. This should yield 177 mph TAS with fuel consumption of 8.1 gal/hr and 1,650 in. r.p.m. Very accurate power settings on all three engine operating parameters are possible with the various controls, especially on fuel pressure which greatly affects range. Use of recommended fuel pressure settings during the gear roll climb, the possibility of barrel valves from too late a closure or on reverse fuel consumption from too early a closure.

The Rangermaster exhibits good handling qualities in all normal service.



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NASA

National Aeronautics and Space Administration Issue

July 2, 1962

Today's most timely aerospace industry subject—The National Aeronautics and Space Administration—will be featured in AVIATION WEEK & SPACE TECHNOLOGY's July 2, 1962 issue.

This massive editorial effort will present, for the first time, a complete analysis in depth of NASA:

1. Current & future plans and programs
2. Expansion of operations & facilities
3. Budgets
4. Management changes
5. New procurement policies

...as well as a long-range forecast of NASA's future in our industry.

How to do business with the fastest expanding part of the aerospace market, scheduled to award contracts exceeding Three Billion Dollars in Fiscal

1963 is a subject that will command the attention of key buying influences and open the door to countless sales opportunities for thousands of manufacturers throughout the country. As an example, in the Mercury project alone over 4,000 sub-contractors participated. The NASA manned space program is projected to cost a \$20 to \$30 billion total over the next decade.

AVIATION WEEK & SPACE TECHNOLOGY has achieved an international reputation for presentations of this type with the Systems Command Issue, "Forging Military Spacepower" (1961); the Strategic Air Command Issue, "SAC in Transition" (1960); the NASA Issue, "Now Decide on Space"

(1959); and the Air Research and Development Command Issue, "Research for Space" (1958). Teams of AVIATION WEEK & SPACE TECHNOLOGY editors are now carrying out assignments covering NASA operations and issues throughout the nation. We urge your company's participation by advertising its products, capabilities and facilities in the most important aerospace issue of 1962.

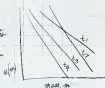
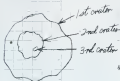
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• Is relevant to engineers and scientists



LUNAR SURFACE RESEARCH

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This Douglas study seeks to increase man's understanding of the character of the moon's surface and how it will react to space-exploring machines and man.

Theoretical investigations are being supplemented by experiments in the Douglas Space Physics Laboratory. Here the effects of high vacuum on simulated properties of the surface of the moon are being studied to define the best model for the lunar surface that satisfies existing data. Moon crater formation is also under study to determine whether volcanic processes are in action.

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can. Speed stability and maneuvering stability are both positive but not to an extent which becomes a nuisance. Controlled turns are possible at cruising speed without the use of stabilizer because of a control coordinator between rudder and aileron, but this action is not powerful enough to interfere with conventional maneuvers when required.

Stalls are dealt with ample warning, occurring from aerodynamic buffet. This holds true for both the climb and landing configurations. Aileron effectiveness is sustained at post-stall angles up to a point of total destruction of the wings which causes the jet to stall first.

Low Speed Level

Second level within the cube is low for an aircraft of this class. Normal cruising is easily done and the radio loudspeaker can be used in lieu of headphones without danger of overloading or straining radio antennas.

Top tank fuel is used once the main tank is depleted to 10 gal, thereby saving the dual purpose of retaining a reserve fuel on the wings in the event of tank failure and also providing fuel overflow in the main tanks. Considerable fuel is returned to the main tanks from the fuel apertures which ease the amount of fuel needed and return the main portion to the main. Operating on top tank fuel depletes the respective tank as well as effectively transferring fuel to the main. Slight wing heaviness

will occur in top fuel is used but this can be overcome by keeping the top wing 30 mm fuel consumption of each other.

Good down speed in the Rangemaster is 150 mph. Extension usually is completed within 1 to 4 sec. The traffic pattern can be flown easily at 110 to 120 mph with the winged viewed to 165 mph, so the final turn. Flap extension is started below 155 mph and for most normal landings, one-half to three-quarter flaps are used with air speed held at 90 mph. Should field conditions dictate, full flaps are used and air speed reduced to 75 mph but care must be exercised in flaring out because the approach angle is very steep. Normal landing roll is 1,000 ft but the landing roll can be reduced to 710 ft.

It is possible under some conditions to overload the Rangemaster because of the large cabin capacity. Fuel load must be less than maximum when few people are carried since the maximum gross weight of 3,315 lb. could be exceeded. It is well also to note that if fuel is off loaded to allow the main tanks to be carried, it is more tank fuel that is needed. The maximum capacity load for the aircraft is 1,049 lb. which means that when over more than 505 lb. of payload is put into the cabin, an amount of fuel equal to the current weight must be left out of the main fuel tank. In all cases it is advisable to fill the top tanks so that the fuel weight supplies a relieving load on the wings.



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ADVISER & SPECIAL PROJECTS DIVISION

Navion Rangemaster Performance

Worst distance, 50-ft altitude (max. gross weight)

Normal altitude at 50 mph 545 ft
Maximum performance at 50 mph 525 ft

Loading distance over 50-ft altitude

Normal approach 90 mph 545 ft
Maximum performance at 75 mph 525 ft

Climb

100 mph at sea level 1,250 fpm

Speed (mph)

Design diving 320 KAS
Normal cruise 180 KAS
Maximum speed 132 KAS
Cruising speed 130 KAS
Wing extension 180 KAS

Speed/Power Data

	blps	mpg	rpm	T/S	gal	max
Maximum maximum power (two level)	246	35.5	3625	194	19.1	
Climb (sea level)	246	29.9	3625	187	13.3	
Emergency cruise (11,800 ft, 10% power)	136	19.1	2490	877	9.8	1,888 stat. mi.
Normal cruise (11,800 ft, 61% power)	165	22.2	2490	101	12.8	1,474 stat. mi.



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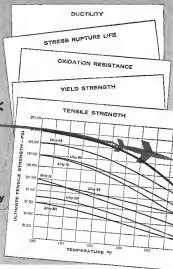
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For complete details, write for Technical bulletin No. 66.

*Used on NASA's X-15 Rocket Motor Nozzle



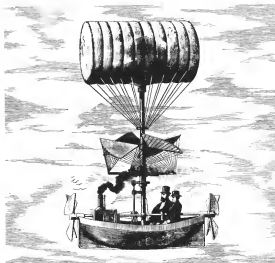
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METALLURGICAL SPECIALISTS



Sferma Marquis, Brantly B-2 Shown at Shackleton

First Sferma B-2 delivered to England (above) is shown at such top of Sferma Executive Aviation Services for display at the annual Shackleton International Business Flying Show at Sywell Airport. The B-2 was used to deliver and landings from the aircraft platform below. Sferma Marquis, take-off-powered version of the Brantly B-2, is displayed. Distributor of the aircraft to the United Kingdom is Short Bros. & Harland, Belfast. Also on the show was the only Brantly product at the show. Also new this year was the Helix Cruiser short, sleek and looking almost down at the Shackleton show by Markham Aviation, Ltd. Later this year a Cessna 180 conversion was shown at the show for the first time by its agent, Kappa Aviation, Ltd.





It looked good on paper, but...

...this 19th-Century concept of an aerial navigation machine by H. Badgley was doomed to failure.

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Lightplane Industry Queried on Collusion

Lead-off position in the Department of Justice Anti-Trust Division's order for investigation of the 418 business and safety aircraft industries was held by Beech Aircraft Corp. during hearings opened in Wichita, Kan., recently by a special grand jury.

Top Beech management and sales executives, two of the company's dealer leaders and dealers and aircraft owners and operators from widely scattered sections of the country were called before the special 12-man panel for questioning by three Justice Department representatives.

The panel was briefed from the proceedings last January when it felt that the threat of the serious indictment that the department's strategy was to develop sufficient evidence against one manufacturer to provide a test case from which the department might move against the rest of the industry.

Hearings opened here last week marked the second phase of the Justice Department's investigation of the industry.

Special grand jury last year subpoenaed considerable documentation from eight business and safety aircraft manufacturers as to their distribution and sales practices, distribution/production agreements, records dating back to 1946 pertaining to industry meetings at which representatives of the companies discussed and discussed reports (AW Mar 13, 1961 p. 25).

Department of Justice representatives also are known to have taken depositions from a number of dealers and customers regarding experiences in sales of airplanes.

Indications are that the major areas of questioning covered by the department's Anti-Trust Division representatives are aimed at determining the following:

- If conspiracy or acts of collusion are involved in sales and promotion activities of the business aircraft manufacturers and their field sales representatives.
- Basis of electronics equipment "package" planning and whether the business aircraft industry is the sales or manufacturer of equipment in aircraft.
- Philosophy of distribution/dealer firm choice and protected sales territories.
- Whether there is exchange of information between the manufacturers regarding production and delivery schedules.

The jury is expected to have testimony and decide if there are grounds for federal charges on the basis of antitrust violations. Indications are that the second phase of the hearing might be concluded the week of and continued until further action is felt.

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Range 0 to 1000 inch pounds

10000-10000 1/2 inch torque





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Said Hans Oersted: "When a conductor carries current through a magnetic field at right angles to it, the resultant reaction thrusts the conductor in a direction perpendicular to both the current and the magnetic field."

A light-weight, low fuel consuming propulsion system is a primary requirement for interplanetary space vehicle travel. One such system now being carefully studied utilizes plasma propulsion.

This concept employs an electrical field to produce a plasma and to energize it. A magnetic field then ejects the plasma, thereby providing a reaction thrust to the vehicle.

Plasma propulsion is but one of many subjects under investigation at Lockheed Missiles & Space Company. Outstanding facilities, equipment and scientific personnel make the organization an eminently capable of exploring many unusual aspects of space travel. This, coupled with Lockheed's favorable locations in Sunnyvale and Palo Alto on the beautiful San Francisco Peninsula, constantly attracts scientists and engineers interested in pursuing work in their special fields.

Why not investigate future possibilities at Lockheed? Write Research and Development Staff, Dept. 36-26A, 999 Mathilda Avenue, Sunnyvale, California, An Equal Opportunity Employer.

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BILL 67-52 drops slingshot at great cable helicopter while hoisting at high altitude. Right is cable car hoisted on rock.

Helicopters Aid Tramway Construction



Fleet of light helicopters is flying better than 50 round trips daily carrying men and equipment to a rendezvous 5,500 ft. above sea level to aid in construction of a tourist attraction in the heart of a granite state forest that is inaccessible by conventional vehicles.

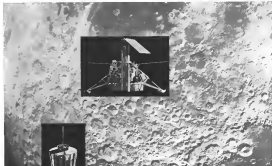
Mission is to build a 57.5 million aerial cable car tramway that will climb nearly 6,500 ft. during a two-and-half mile ascent to the east face of Mt. San Jacinto overlooking Southern California's Palm Springs. Passengers will ride from the desert to a new resort in 10-15 minutes. Sixty-foot cable car.

Since mid-September, Bell 470's and 470B's of United Helicopters, Inc., have been making the 15-minute flight up and 4 men, whom they haul—log, sand, gravel, water, fuel, cement, tractors, portable building material, stoves, refrigerators, food, medicine, dental tools, jackhammers, lumber, steel and personnel to the construction site. During the first four months, the helicopters flew 1,183 hours of service.

At the heliport, men hoist logs have been built for feet above the ground for loading and unloading cargo and personnel. United Oil Co. has provided a 5,600-gal. tank to speed refueling.

Each helicopter averages about three round trips per hour. In addition to supplying men and material to the project, supplies are also airlifted to areas traversed by men being hoisted up and lowered into the face of the steep cliff. Helicopters are being converted to the side of the cliff at lower levels to facilitate their service after the tramway becomes operational.

AERIAL view shows routes and slingshot at which support helicopters meet agents.



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SUPPLY (left) lunar landing space craft, SYNCOM (synchrosatellite) communications satellite, APMAT (airborne anti-battle missile defense system) (SAM) (anti-battle missile defense feasibility study) These are a few of the many important and complex projects under design, development and study at Hughes. Because of these projects and others important to the nation's defense, pre-precision and space effort, Hughes offers more opportunities to Systems Analysts than ever before. Involved with these positions are the consideration of many basic problems such

as the proper mix of manned vs. unmanned satellites, the requirements of manned space flight, IR systems requirements for high speed strike weapons, some systems of automated satellites, analysis of weapon systems from conception through development, test and customer use and many others.

Inquire today, if you are a graduate engineer or physicist from an accredited university, a U. S. citizen, and believe that you can contribute to and benefit from the important projects at Hughes, contact us today. Annual pay ranges by:

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NEW AEROSPACE PRODUCTS

De-Icing Tester

An icing tester, developed to check the de-icing heater on the Canadian CL-44 transport aircraft, has no moving parts and provides 180 lb. min. of ice at 40 in. water pressure and 10.11°F above ambient temperature in the test section area.



The unit is attached to a truck-mounted gas turbine compressor for power source. Compressor bleed air is fractured with two jet pumps and a heat exchanger. The heat exchanger draws that the unit also is heated to ground heating and pressure tests in Boeing 787 and Douglas DC-8 jet transports.

Trivac Corp., Torrance, Calif.

Airborne Hydraulic Pump

New AP2V Series pump integrates a basic variable volume piston, for application to aircraft, tanks, fluid power and ground support equipment.



Manufacturer rates the pump will deliver approximately 10 gpm at 3,000 rpm and 5,000 psi, with maximum displacement of 0.58 cu. in. per revolution. The single-stage, constant-volume unit has a pressure compensator valve to regulate volume according to system demand to meet pre-determined pressure requirements.

The unit weighs 64 lb. and offers fast response and high pressure-weight ratio, the manufacturer claims.

Kellogg Division, Armstrong Brake Shoe Co., 1013 W. 5th St., Oxnard, Calif.



Lea Tank Purge System

Mobile dry air system is designed for purging service liquid oxygen tanks to prevent internal rusting after hydrostatic tests.

Model C8-180 system consists of an oil free compressor, direct air separator and water separator. It delivers three cubic ft. of 100% dewpoint air at 50 psig.

The dry air is stored to eliminate wet, contaminant pockets that are larger than 10 microns.

Kendy Equipment Corp., Cortland, N. Y.



Temperature Control Valve

Automatic device, controls self-contained and expanding no external power, continuously mixes hot and cold in coming fluids and sports a flow of constant temperature fluid.

Valve is designed to operate in air borne, hot-exchange systems. Gelpart fluid temperature is maintained by the valve to maintain a 7 gpm rate at 40°F.

Valve operates in ambient temperatures from -65 to 160°F and is designed to handle a variety of fluids at pressures of 200 psi nominal, 300 psi burst pressure.

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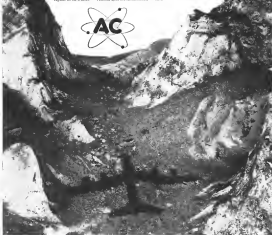
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WHO'S WHERE

(Continued from page 21)

Honors and Elections

Dr. Harold C. Urey, professor at the University of Colorado in Boulder, has been elected the National Academy of Sciences' J. Lawrence Smith Medal for outstanding achievement in the investigation of scientific issues.

Changes

Dr. Gerald M. Matsumoto, program director laser systems, Martin Co.'s Space Systems Division, Baltimore, Md.

Dr. Everett Strong, director, Space Systems Laboratory, Western Development Laboratories, of Palo Alto, Calif., a subsidiary of Ford Motor Co.

Dr. Walter E. Griesel, director of research, Vought Division, Northrop Corp., Van Nuys, Calif.

Mr. Gen. F. H. Baker, USAF, retired, program manager Project STUR, Advanced Manufacturing Co., Phoenix, Ariz.

Col. John T. Ward, USAF, chief of the new Flight Inspection and President Division, Federal Aviation Agency, Flight Standards Service.

Walter L. Pruthi, head of the new wing and joint project management group, and chief, Northrop Co.'s Support Division, Lexington, Mass.

Richard M. Whitaker, chief engineer R-1 Systems Division of Radiometrics of Stanford, Palo Alto, Calif., a subsidiary of Radio Inc.

Howard F. Thomas, manager of Space Guidance Co.'s Westville, Ark., office.

Robert B. Clifford, general sales manager, Military Products Corp., Minneapolis, Minn., and Robert H. Wiesner, director of contract relations, John Wiley & Sons.

Mr. Clifford as director of marketing for the Astronautical Division.

Dr. Everett J. Schubert, manager, Systems Research Section for the Systems Division, Rockwell International, Inc., Pomona, Calif.

Dr. W. W. Haskins, general manager, Mission Division of The Bendix Corp., South Norwalk, Conn.

Dr. John J. Myers, director of engineering, Western Inertial Laboratory, Section, North American Aviation Co., Columbus, Ohio, Dec. 1969.

Thomas A. Holloman and Louis M. Thomas, associate heads of The Utah Corp.'s new Tactical Systems Department, Bedford, Mass. Also, James Allen, assistant head, Strategic Systems Department.

Edward F. Hensley, manager reliability and safety, Dyna Star Program, Boeing Co., Seattle, Wash. Robert M. Bonaldi, controls Mr. Hensley in safety integration staff, Boeing's B-71 and B-47 programs, Walling.

Edgar Hook, engineering manager, Naval Systems Electronics Division of Crane Co., Fairport, Conn.

Hugh C. Banta, marketing manager, Aerospace Division, LSC, Inc., Santa Monica.

James E. Kuch, program manager, and Robert C. Haskins, engineering manager, Goddard Range and Range Role System, Motorola's Military Electronics Division, Scottsdale, Ariz.

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PROBLEMATICAL RECREATIONS 118



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